7.5 Urban Water Supply Economics

The CALFED Bay-Delta Program would both benefit and adversely affect urban water supply economies. Many of these economic effects cannot be determined until more project-specific information is available.

7.5 Urban Water Supply Economics

Urban water supply economics relates to the factors and relationships that determine the costs of water for urban uses. Many factors are involved, including the demand for and supply of water resources, the costs of building facilities to supply water, the costs of treating water, and the costs and availability of alternative water supplies. At this programmatic level of analysis, much of the information needed to specifically analyze the costs and benefits of CALFED Bay-Delta Program (Program) actions to urban water supply economics is not available and will not be available until specific sizes, locations, and other specifications of projects are known. In practice, integrated water management would be used to develop efficient urban water supply and quality measures, using lease-cost planning perspective. This section presents a general discussion of the effects of Program actions on urban water supply economics and notes where information is not adequate to discuss effects.

Many factors are involved in urban water supply economics, including the demand for and supply of water resources, the costs of building facilities to supply water, the costs of treating water, and the costs and availability of alternative water supplies.

7.5.1 SUMMARY

Preferred Program Alternative. The Ecosystem Restoration Program could benefit urban water suppliers and users by lower regulatory costs. Some undesirable water quality constituents such as organic carbon could be increased by land conversion to wetlands in the Delta. No cost estimates or cost-sharing guidelines are currently available, but the share of costs paid by urban providers could be an adverse effect.

The Water Quality Program could benefit urban water suppliers and users by improved source water quality, lower treatment and regulatory costs, and relocation of water supply intakes. No cost estimates or cost-sharing guidelines are currently available.

The Water Use Efficiency Program will require expenditures to obtain conservation and water reuse goals. The magnitude of these costs in relation to No Action Alternative conservation costs is uncertain. Water revenue reductions and program costs may require water price increases, but costs of new supplies would be avoided.

The Long-Term Levee Protection Plan could benefit urban water providers by reducing the risk of export interruptions caused by levee failure. Currently, it is not clear who would pay the costs of about $1.5 billion. Therefore, economic effects on urban water providers cannot be estimated.

The Water Transfer Program could affect urban water providers in many ways, including water supply, supply costs, and water quality. The availability of water transfers might affect selection of local supplies and other imported supplies. Water transfers may facilitate urban land use and development where water supply constraints otherwise would limit growth.

The Watershed Program would provide technical assistance and funding for watershed activities and protection relevant to achieving Program goals and objectives. The program would be phased to allow for adaptive management. No cost information is currently available.

Storage and conveyance features and improvements are expected to benefit water supply economics for CVP and SWP urban water providers. Benefits involve water quality as well as quantity. The significance of these benefits will depend on population growth, baseline conditions unique to each provider and the amount of storage included in the staged implementation of the Preferred Program Alternative.

Total water supply increases under 2020 conditions with new storage are from 100 TAF to 1 MAF in critical periods and from 600 TAF to 1 MAF on average. The share of this water to be provided to agriculture is currently unknown. However, a range of assumptions on water management and allocation suggests that urban users would receive 40-400 TAF of new supplies in dry periods and 100-300 TAF on average.

Total water supply increases under 2020 conditions with new storage are from 100 TAF to 1 MAF in critical periods and from 600 TAF to 1 MAF on average. The share of this water to be provided to agriculture is currently unknown.

Most urban water supply benefits would occur in the South Coast Region. DWR's least-cost analysis suggests that costs of conservation, recycling, and drought shortage avoided by new surface storage supplies amount to $500-$1,500 per acre-foot of new average water delivery. Total South Coast Region benefits would range from $13 to $40 million annually without new storage, and from $80 to $240 million annually with new storage, depending on management criteria and allocation priority. Benefits in the Bay Region are less because the share of new water supply is less and the per-unit benefit is less. The Bay Region has limited need for new water supplies in average hydrologic conditions. Total Bay Region benefits would range from $1 to $3 million annually without new storage, and from $3 to $19 million annually with new storage, depending on management criteria and allocation priority.

Results are contingent on water management criteria, allocation priority, and implementation of Water Use Efficiency Program actions. All Program alternatives include the Water Use Efficiency Program. If recycling and conservation are implemented at levels suggested by the Water Use Efficiency Program, much of the value of new water supplies would not occur, because the high levels of recycling and conservation eliminate the need for the new supplies. If new supplies are allowed to replace some recycling and conservation, however, the value of the new supplies is very high because the avoided costs of the recycling and conservation are very high.

Conveyance improvements are expected to affect economics associated with salinity and DBP precursors. Reduced salinity costs could approach $100 million annually. These values may be substantially affected by many factors that currently are uncertain. Some stakeholders feel that benefits are overstated. For example, increased use of reverse osmosis (RO) for water treatment and subsequent reduction of baseline salinity levels could substantially reduce these benefits.

Economic benefits associated with DBP precursors have not been estimated, but bromide concentrations could be reduced by improved Delta conveyance. The cost for RO to remove DBP precursors could amount from $200 to $500 per acre-foot of Delta water for potable use, and some of this cost might be avoided by improved Delta conveyance. Future economic analysis would be complicated by changing technology and drinking water quality requirements. In particular, ultra-violet (UV) treatment technology may eliminate the need for RO and would substantially reduce the economic benefits of improved conveyance associated with DBPs.

Total costs of the storage and conveyance components are estimated at $4-$12 billion. The allocation of these costs among water users and other interests is unknown. Storage and conveyance cost repayment is expected to adversely affect water supply economics. The significance of these adverse impacts will depend on cost allocation and repayment requirements that will be developed in the staged implementation of the Preferred Program Alternative.

Total costs of the storage and conveyance components are estimated at $4-$12 billion. The allocation of these costs among water users and other interests is unknown.

Alternatives 1, 2, and 3. The pattern of potential beneficial and adverse effects on urban water supply economies associated with Alternatives 1, 2, and 3 is largely the same as described for the Preferred Program Alternative. These alternatives differ from the Preferred Program Alternative primarily in the effects on conveyance costs and water quality costs. Due to the programmatic nature of this document, the costs cannot be determined at this level of analysis.

7.5.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that are currently unknown or reflect differing opinions among technical experts. Unknown information includes data that are not available and cannot readily be obtained. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Given the programmatic nature of this document, these areas of controversy cannot be addressed; however, subsequent project-specific planning and environmental analysis will evaluate these topics in more detail. Data are not available for the following issues.

- The amount of RO or other treatment technologies in place in 2020 (regardless of conveyance facilities) is currently unknown but could substantially influence water quality benefits from the Conveyance Element.

- No methods are available to evaluate the economic benefits of changes in concentrations of DBP precursors.

- Information about cost allocation and recovery for Program actions and facilities is not available.

- Allocation of water to urban water users is uncertain because irrigation users' willingness to pay is uncertain.

The Program recognizes the importance of urban water supply economics to regions potentially affected by Program actions. The costs, benefits, and patterns of urban water supply cost allocation for Program actions have yet to be developed. Economic impacts cannot be identified until the location of specific projects and allocation of water are identified. It should be noted that neither CEQA nor NEPA treats social and economic effects as environmental impacts. CEQA requires a discussion of economic and social effects only if they will lead to physical changes in the environment. NEPA requires a full discussion of economic and social effects but, as with CEQA, does not treat them as environmental impacts in and of themselves. Consequently, this Programmatic document fully discusses social and economic issues, as required by NEPA, but consistent with state and federal law, does not treat adverse social and economic effects as significant environmental impacts.

7.5.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

In an economic analysis, the specific groups of affected persons must be described. The term "provider," as used in this section, includes all persons with a direct economic stake in water supply and costs. End-users of water, shareholders in private water utilities, and any public or private interests who pay any part of the costs or receive the benefits of water services qualify as a provider.

End-users of water, shareholders in private water utilities, and any public or private interests who pay any part of the costs or receive the benefits of water services qualify as a provider.

Parts of the San Felipe Division of the CVP are included under both the Bay Region and the Other SWP and CVP Service Areas in the "Affected Environment/Existing Conditions" descriptions. For the remainder of the urban water supply economic analysis, however, the San Felipe Division of the CVP is included only under the Bay Region.

7.5.3.1 DELTA REGION

The Delta urban providers include the cities of Pittsburg, Antioch, Tracy, Brentwood, Isleton; parts of Stockton and Sacramento; and a variety of small communities and residential users around the Delta.

Total urban water use in the Delta has increased over time with the increase in population. Figure 7.5-1 shows population trends for some Delta urban providers.

Total urban water use in the Delta has increased over time with the increase in population.

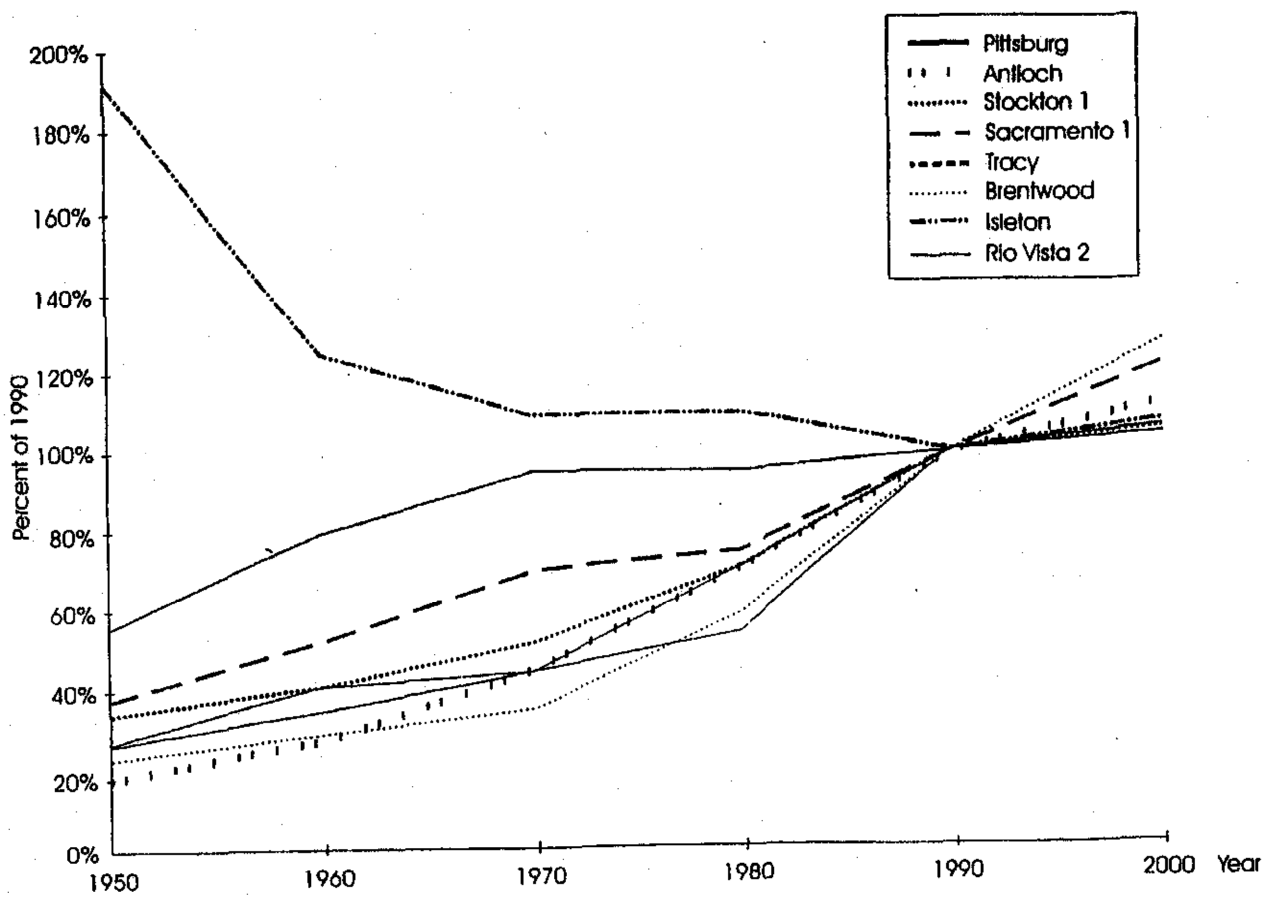

Figure 7.5-1. Population Trend for Some Delta Region Municipal and Industrial Providers as a Percentage of 1990 Population

Table 7.5-1 shows population, water use, and cost data for some major Delta providers. Industrial use occurs within the service areas of these providers, and a few large industrial users divert a significant share of total urban use within the Delta.

Table 7.5-1. Characteristics of Some Delta Region M&I Providers

PROVIDER	POPULATION (1995)	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	WATER INTO SYSTEM (1990 af)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	AVERAGE COST ($/af)
Pittsburg	50,400	47,564	3,066	9,411	12,313	176	100	99	100	$952
Antioch	69,500	62,195	3,823	11,734	18,801	168	64	100	100	$702
Stockton[a]	226,300	210,943	17,130	52,578	64,179	183	52	100	52	$311
Sacramento[a]	391,100	369,365	37,157	114,048	111,785	272	0	3	95	$165
Tracy	40,500	33,000	3,345	10,267	9,964	270	42	100	42	$485
Brentwood	9,675	7,563	532	1,633	2,278	193	0	100	0	N/A
Isleton	870	833	83	255	353	273	0	100	0	N/A
Rio Vista[b]		3,316	370	1,136	1,403	306	0	14	0	N/A

Notes:
af = Acre-feet.
mgd = Million gallons per day.
N/A = Not applicable.

[a] Only part of the provider is located in the Delta.
[b] Borders the Delta.

Source:
DWR 1994.

Figure 7.5-2 shows 1980-1990 use by the Delta providers as a percentage of 1990 use. Costs of existing and additional water supplies for Delta providers differ substantially, depending on existing and potential sources of water. Water costs in CCWD, in the City of Tracy and, to a lesser degree, in Sacramento and Stockton are affected by CVP policies. In many locations, raw water costs will be affected by groundwater development and extraction costs.

In 1992, the City of Tracy filed a water rights application with the SWRCB to divert water from the Delta near the Westside Irrigation District pump station on Wicklund Road. The City also may propose to convert existing agricultural rights to urban uses as the land is developed, and may propose to wheel both of these supplies through the Delta-Mendota Canal to the City's water treatment plant. The 1998 CVP contract rate for the City of Tracy was $37.02 per acre-foot, plus a restoration fund charge of $13.76.

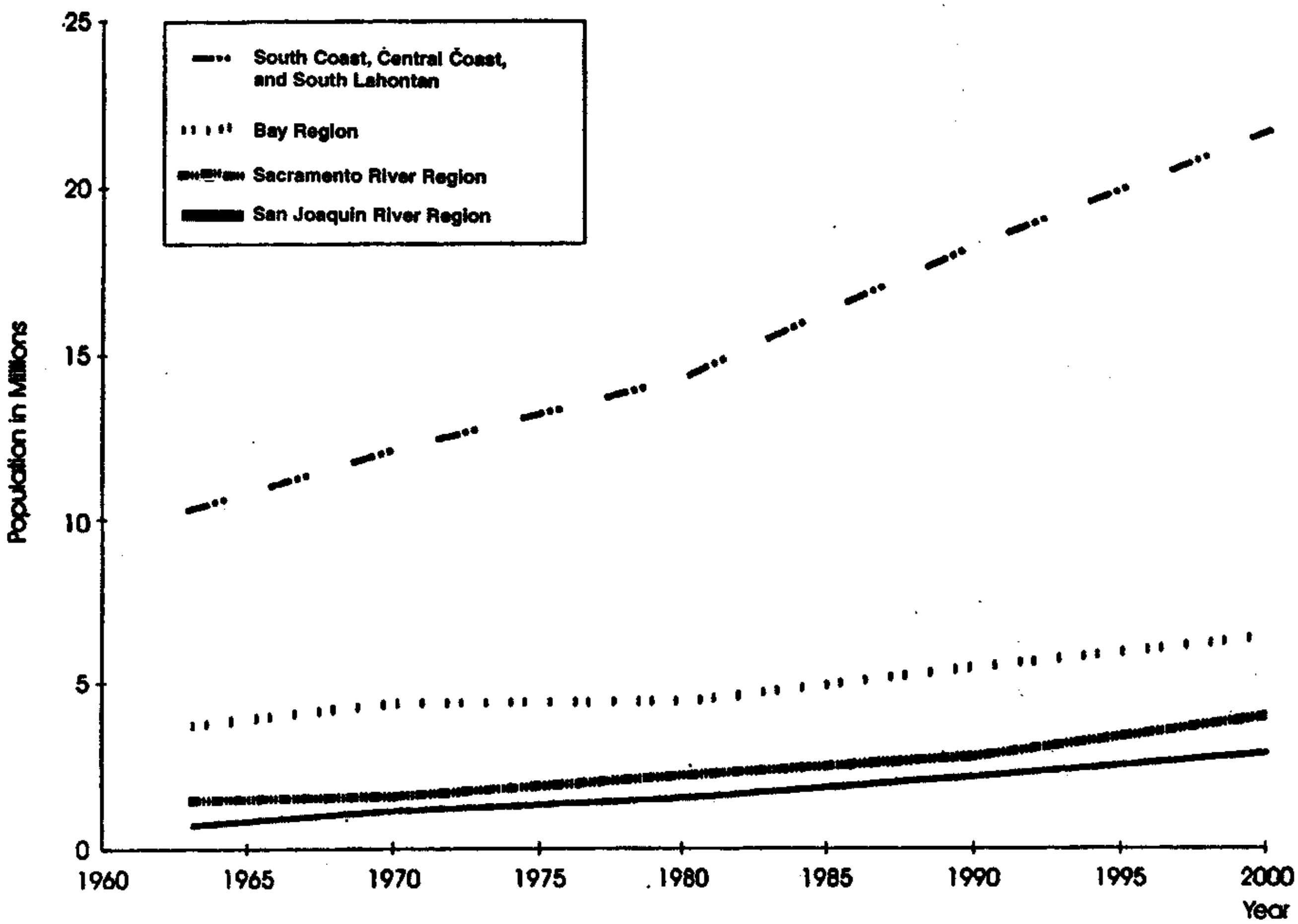

Figure 7.5-2. Bay Region Population Trends by Program Region, 1963 to 1990, and Predicted Population, 2000

The City of Sacramento serves water to a section of the city within the Delta. Much of this area is commonly known as "the Pocket." The Delta also includes part of south Sacramento. The City provides water from the Sacramento and American Rivers and from groundwater. The City does not divert surface water from within the Delta Region.

West Sacramento serves urban uses west of the Sacramento River and within the Delta. Surface water and groundwater are used. Approximately 9.7 TAF were diverted into the system in 1995, of which approximately 9 TAF were surface water. Surface water is taken from the Sacramento River under water rights and a CVP contract at a point within the Delta just north of I-80. The 1998 CVP contract rate was $15.47 per acre-foot, plus the restoration charge.

The City of Stockton is served by three purveyors: the California Water Service Company, the City of Stockton, and San Joaquin County. Each of these agencies serves parts of the Delta. The only direct diversion of water from the Delta is for several golf courses and small landscape uses. Most urban water originates from groundwater, from the Calaveras River through Stockton East Water District, and from the Stanislaus River through the CVP. The share of supplies provided by surface water and groundwater varies according to hydrologic conditions. The City supplies a small parcel in the Delta with reclaimed water.

The City of Stockton submitted an application to the SWRCB to divert up to 45 TAF annually from the San Joaquin River downstream of the City's existing wastewater treatment plant. The diversion would recover "an amount of water equal to that discharged into the San Joaquin River at the City's Regional Waste Water Control Plant." The additional water would be brought into the city for treatment or would be provided to agriculture in exchange for groundwater currently used for agriculture.

CCWD serves lands within and outside the Delta in Contra Costa County. CCWD currently provides municipal water in the Delta for the cities of Antioch and Pittsburg and to Oakley Water District. Most of CCWD's water is obtained through a 195-TAF contract for CVP water, which is pumped from the Delta into the Contra Costa Canal from Rock Slough. CCWD also can pump up to 26.7 TAF annually from Mallard Slough and has agreed to use up to 21 TAF per year of East Contra Costa Irrigation District (ECCID) water to serve urban demands within ECCID. Existing raw water costs for CCWD are influenced by CVP rate-setting policies and the CVPIA. The 1998 CVP contract rate was $42.79 per acre-foot, plus the restoration charge. Water costs to wholesale buyers and also at the retail level are being affected by the Los Vaqueros Reservoir Project.

The 1998 CVP contract rate was $42.79 per acre-foot, plus the restoration charge.

The City of Antioch obtains its supply from CCWD and from a separate Delta diversion under a 7,670 acre-foot right. The diversion and treatment facility can handle up to 8.2 million gallons per day (9.3 TAF per year), but water quality limits that amount. The salinity of the water at the diversion determines when water will be diverted, as well as the share of the City's water provided by the diversion as opposed to that supplied by CCWD. Typically, diversion ceases when salinity reaches about 200 parts per million (ppm), but diversion may continue at higher salinity if water quality (as a function of the tidal cycle) is expected to improve. As suggested by Table 7.5-1, Antioch is able to supply about 35% of its water needs with this diversion.

The City of Brentwood currently relies on groundwater for its water supplies, but the City has an agreement with CCWD to acquire up to 7 TAF annually in the future. Some of this need will be met with the 21 TAF CCWD has agreed to distribute for ECCID.

Additional towns and communities in the Delta Region not included in Table 7.5-1 or in the discussion above include Bethany, Bethel Island, Byron, Collinsville, Courtland, Discovery Bay, Four Corners, Freeport, Hood, Oakley, Ryde, San Joaquin City, Terminous, and Walnut Grove. Most of these towns are served by a larger provider, a small district, or individual groundwater wells. Oakley is served by Diablo Water District, which obtains raw water from CCWD. The City of Antioch is the purveyor for the Discovery Bay area. Bethel Island residential users are served by several small water districts.

Other industrial users in the Delta divert water under individual water rights. CCWD lists the following industrial water users and their annual diversion right: Gaylord Container Corporation (28 TAF), El Dupont De Nemours & Co. (Dupont) (1,405 acre-feet), Tosco Corporation Lion Oil Division (16,650 acre-feet), and USS Posco (12.9 TAF). Dupont obtains most of its water needs through Diablo Water District. All of these users, except for Dupont, also obtain water through CCWD. Shell Oil also is an important industrial customer for CCWD, diverting about 10 TAF annually from the Contra Costa Canal. Total industrial water sales by CCWD ranged from 27 to 48 TAF between 1984 and 1993, accounting for about one-third of CCWD's raw water demand.

Other industrial users in the Delta divert water under individual water rights.

7.5.3.2 BAY REGION

Early in the state's history, population growth along the coast outstripped the ability of the coast's small and seasonally dry watersheds to provide adequate water supplies. Urban providers built projects, such as the Hetch-Hetchy, to bring water from more reliable supplies. Continued growth led to projects such as the SWP and CVP. The Bay Region includes areas served by any of four facilities that export water from the Delta for urban use: Contra Costa Canal and the San Felipe Division of the CVP, and a portion of the NBA and the SBA of the SWP. In addition, some other areas are affected because of water exchanges that occur involving the Hetch-Hetchy and South Bay Aqueducts.

Early in the state's history, population growth along the coast outstripped the ability of the coast's small and seasonally dry watersheds to provide adequate water supplies.

Figure 7.5-2 shows population in the Bay Region from 1963 to 1990 and projected population to 2000. The region's population increased from about 4.537 million in 1970 to 5.484 million in 1990, for an annual growth rate of 2.25%. The growth rate slowed between 1990 and 1995.

Increased real incomes and new water-using technologies increased per capita use. As urbanization spread eastward in the region, the warmer climate and increased average lot size increased average per capita use. More recently, urban water conservation measures have slowed these trends. Table 7.5-2 shows per capita water use in the Bay Region in 1968, 1980, and 1990. Since 1968, per capita use has increased slightly, probably due to new residential development in the warmer, more inland portions of the region.

Table 7.5-2. Per Capita per Day Water Use, Bay Region, 1968 to 1990 (gallons)

YEAR	ALL USES
1990	193
1980	180
1968	179

Sources:
DWR 1994, 1983, and 1970.

The Bay Region currently relies on the SWP and CVP for about 30% of its urban water demands. Without the East Bay Municipal Utilities District (EBMUD), the share rises to about 40%. Table 7.5-3 shows recent imports into the region through the SWP and CVP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. Most imported water is delivered through the Contra Costa Canal and the SBA, with smaller shares delivered through the CVP's San Felipe Division and the NBA. Table 7.5-4 shows characteristics of some Bay Region urban providers.

Table 7.5-3. M&I Water Delivered to the Bay Region by the SWP and CVP, 1990 to 1994 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Contra Costa Canal	186,679	153,363	109,576	93,267	134,903
San Felipe Division	65,390	53,352	69,530	56,066	81,842
State Water Project					
North Bay Aqueduct	26,071	8,352	16,171	24,234	--
South Bay Aqueduct	156,737	50,259	76,661	124,180	--
Total	**434,877**	**265,326**	**271,938**	**297,747**	**216,745**

Notes:
Does not include water rights deliveries or water transfers.
-- = Not available.

Sources:
Reclamation 1996, DWR 1996.

Costs of existing and future water supplies are affected by the mix of supplies and their costs. DWR estimated that groundwater for urban use in the region costs from $85 to $330 per acre-foot. Costs of CVP supplies currently range from $42 to $95 per acre-foot, plus the restoration fund charge of about $14. DWR estimated SWP unit water charges for North and South Bay contractors of $212 and $109 per acre-foot, respectively. Because local water supplies generally are fully utilized, future supply increases are likely to come from additional water imports or reclamation. The region generally has adequate water supplies during average conditions, but supply deficits are a problem in dry conditions. Water transfers and conservation were used during the recent drought to attain a balance between supplies and demand, and this pattern is expected to continue in the future.

Table 7.5-4. Characteristics of Some Bay Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Vallejo	109,199	7,087	35,000	178	79	100	100	--
Fairfield	77,211	5,405	19,088	192	100	100	100	--
Vacaville	71,479	4,720	20,412	181	53	100	53	--
San Francisco	723,959	31,685	164,892	120	0	100	100	$484
Palo Alto	56,000	4,465	18,912	218	100	100	100	--
San Jose	873,714	41,154	201,150	129	47	100	55	$664
Santa Clara	93,800	7,988	23,031	233	38	100	38	--
Sunnyvale	117,229	7,606	27,434	178	80	100	80	--
Pleasanton	50,570	4,818	16,195	261	68	98	68	--
Concord	190,000	12,107	54,538	175	100	100	100	--

Note:
af = Acre-feet.
mgd = Million gallons per day.
-- = Not available.

Source:
DWR 1994.

Three subregions within the Bay Region are internally independent in terms of water supply: the North Bay, the South Bay, and CCWD. The North Bay consists of SWP entitlement holders served by the NBA of the SWP and others who have used or could use this facility in exchanges. Two water districts are served by the NBA: Napa County Flood Control and Water Conservation District (NCFCWCD), and Solano County Flood Control and Water Conservation District (SCFCWCD). NCFCWCD serves SWP water in southern Napa County. SCFCWCD serves the cities of Vallejo, Vacaville, Fairfield, Benicia, and Suisun City. The two districts have transferred water and obtained surplus water through the facility. In addition to SWP entitlement water, Vallejo receives water-rights water through the NBA.

Three subregions within the Bay Region are internally independent in terms of water supply: the North Bay, the South Bay, and CCWD.

The South Bay is served by the SBA, an SWP facility, and through CVP contract supplies supplied through the San Felipe Division. Three SWP entitlement holders—Alameda County Water District, Alameda County Zone 7, and the Santa Clara Valley Water District (SCVWD)—are located in the South Bay. SCVWD also is served by the San Felipe Division of the CVP and wholesales water in a large part of the south San Francisco Bay.

For this analysis, the CCWD subregion includes that portion of the district not within the Delta. This area includes the cities of Concord, Walnut Creek, Pleasant Hill, and Martinez, and other areas south and west of the Delta.

Per capita use is generally greatest in the southern and eastern parts of the Bay Region. Many providers rely entirely on water wholesalers for their supplies. Water users in the region are almost entirely metered, and groundwater is an important part of supply for some providers.

7.5.3.3 SACRAMENTO RIVER REGION

The Sacramento River Region includes the CVP service areas of urban providers in the Sacramento Valley and a small SWP service area in the Feather River Basin.

The first use of the Sacramento River Region was for grazing and trapping, but the first significant immigration into the region involved the Gold Rush period of 1849 through the late nineteenth century. Most of the population lived in mining communities in the foothills, and Sacramento grew first as a port for delivery of goods and people from San Francisco, and later as the terminus of the first transcontinental railroad. Agriculture developed to serve the mining communities, and the designation of Sacramento as the state capitol led to additional growth. Economic patterns in the twentieth century have mirrored national trends as services, trade, and government have become larger shares of the economy, while mining and agriculture have declined in relative terms.

The historical population trend in the Sacramento River Region from 1963 to 1990 and the projected population to 2000 is shown in comparison to other regions in Figure 7.5-2. Population increased from about 1.227 million in 1970 to 2.209 million in 1990, for an annual growth rate of 8.26%. The growth rate slowed between 1990 and 1995.

Table 7.5-5. Per Capita per Day Water Use in the Sacramento River Region, 1968 to 1990 (gallons)

YEAR	ALL USES
1990	301
1980	305
1968	351

Sources:
DWR 1994, 1983, and 1970.

Table 7.5-5 shows per capita water use in the Sacramento River Region in 1968, 1980, and 1990. Since 1968, average per capita use has declined, possibly due to smaller lot sizes and conservation measures in new residential developments.

The Sacramento River Region generally has adequate supplies, even during drought; and some providers have excess supplies in the form of unused contracts, water rights, and excess groundwater capacity. DWR estimated that urban groundwater in the region costs from $50 to $80 per acre-foot. Some providers, however, depend entirely on CVP water service contract supplies for their water, and these supplies can be reduced in dry conditions. CVP contract supplies currently cost anywhere from $9 to $59 per acre-foot, plus restoration costs. Some CVP water users have no other supplies. For these providers, drought conservation and water transfers may be used in the future to obtain a balance between supply and demand.

The Sacramento River Region generally has adequate supplies, even during drought; and some providers have excess supplies in the form of unused contracts, water rights, and excess groundwater capacity.

The Sacramento Valley has relatively abundant water supplies of good quality in comparison to the other regions. The region also differs from the other regions in that it does not use urban water exported directly from the Delta. Rather, surface water diversions reduce the amount of surface water flowing into the Delta.

The Sacramento Valley has relatively abundant water supplies of good quality in comparison to the other regions. The region also differs from the other regions in that it does not use urban water exported directly from the Delta.

Most urban water use in the region occurs in the Sacramento metropolitan area. Most surface water use in the region is diverted from the American River under CVP contracts. Direct diversions from the Sacramento River may provide a larger share of supplies in the future. Another large user is the City of Redding, and the CVP provides municipal water service to about 10 small urban providers in the Redding area.

Table 7.5-6 shows recent diversions for urban use for the Sacramento River Region delivered through CVP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. Most providers in the region have water service contracts that exceed their immediate needs; therefore, reductions in deliveries during the drought were not as noticeable as in some other regions.

Table 7.5-6. M&I Water Delivered to the Sacramento River Region by the SWP and CVP (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Clear Creek Unit	1,451	659	2,460	2,076	2,329
Cow Creek Unit	3,342	1,817	3,206	5,342	6,674
Folsom Dam and Reservoir	27,454	40,743	23,360	20,895	30,693
Folsom South (SMUD)	5,829	3,600	3,564	1,673	1,727
Sacramento River	8,900	7,753	7,945	8,314	9,321
Shasta Dam and Reservoir	1,852	1,417	1,017	2,694	1,338
Spring Creek conduit	638	337	777	885	688
Toyon pipeline	2,471	2,071	2,537	2,164	2,479
State Water Project					
Feather River area	1,448	866	2,128	3,476	--
Total	**53,385**	**59,263**	**46,994**	**47,519**	**55,249**

Notes:
SMUD = Sacramento Municipal Utility District.
-- = Not available.
Does not include water rights deliveries or water transfers.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-7 shows some characteristics of Sacramento area urban providers. Per capita use rates are among the highest in the state, reflecting climate, landscaping, and pricing factors. Some providers rely entirely on the CVP for their supplies. A large share of water users in the region are not metered. Groundwater is the sole source of supply for some providers; however, some rely entirely on surface water deliveries, especially CVP water-service water. Water costs per acre-foot delivered are generally low in comparison to other regions.

Table 7.5-7. Characteristics of Some Sacramento River Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Redding	66,462	6,890	21,112	284	70	100	70	$254
Sacramento, Citizens Utility	166,000	16,055	46,064	265	0	100	0	--
Fair Oaks	38,005	4,949	12,641	357	95	6	95	--
Roseville	44,685	4,642	17,249	285	100	10	100	--
Sacramento, City of	369,365	37,157	111,785	276	0	2	95	$165
Orangevale/ Roseville	20,000	4,309	6,402	590	100	6	100	--
Carmichael	38,550	4,191	10,830	298	60	5	60	--

Notes:
Metered percentage based only on available data for all service connections.
af = Acre-feet.
GPCD = Gallons per capita per day.
mgd = Million gallons per day.
-- = Not available.

Source:
DWR 1994.

7.5.3.4 SAN JOAQUIN RIVER REGION

The San Joaquin River Region includes only those urban providers in the San Joaquin Valley with some current or planned use of CVP or SWP supplies exported from the Delta. CVP water service contracts in the region that may be affected are served by the Delta-Mendota or San Luis Canal. SWP entitlements are served via the California Aqueduct.

The historical population trend in the San Joaquin River Region from 1963 to 1990 and the projected population to 2000 are shown in comparison to other regions in Figure 7.5-2. Population increased from about 1.676 million in 1970 to 2.974 million in 1990, for an annual growth rate of 7.72%. The growth rate slowed between 1990 and 1995. Table 7.5-8 shows per capita water use in the San Joaquin River Region in 1968, 1980, and 1990. Since 1968, per capita use has declined, probably in response to smaller lot size, more use of modern conservation in new housing, and perhaps changing patterns of water use in industry and commerce.

Table 7.5-8. Per Capita per Day Water Use, San Joaquin River Region 1968 to 1990 (gallons)

YEAR	ALL USES
1990	309
1980	355
1968	436

Source:
DWR 1994.

Table 7.5-9 shows recent imports into the San Joaquin River Region through SWP and CVP facilities. These data show the influence of the recent drought and reduced allocations, especially in 1991 and 1992. Most Delta water delivered into the San Joaquin River Region is provided to Kern County Water Agency (KCWA). The City of Bakersfield obtains SWP urban supplies through KCWA. This water is delivered for several uses within Kern County in exchange for groundwater pumped by the City of Bakersfield.

Table 7.5-9. M&I Water Delivered to the San Joaquin River Region by the SWP and CVP, 1990 to 1994 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Cross Valley Canal	459	407	297	0	0
Delta-Mendota Canal	5,531	5,586	7,221	8,005	7,843
San Luis Canal	12,996	10,528	15,098	11,787	14,374
State Water Project					
Kern County Water Agency	127,837	33,122	56,305	94,220	--
Total	**146,823**	**49,643**	**78,921**	**114,012**	**22,217**

Notes:
Does not include water rights deliveries or water transfers.
-- = Not available.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-10 shows characteristics of some San Joaquin Valley urban providers. Per capita use rates are generally higher than in the coastal regions, reflecting climate and landscaping factors.

Local water supplies are often unable to meet local demands, and supplemental water is exported from the Delta. SWP and CVP water is pumped from CCFB in the Delta and is transported into the region via the California Aqueduct and the Delta-Mendota Canal.

The largest CVP urban water users in the San Joaquin River Region are Avenal, Coalinga, Huron, and Westlands Water District; but small amounts of urban water are taken by a number of other districts. Stockton East is included in this group, with a CVP contract of 38 TAF. Urban water use in the Friant Division of the CVP is not included in this analysis.

Table 7.5-10. Characteristics of Some San Joaquin River Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Stockton	210,943	17,130	64,179	222	52	100	52	$311
Huron	4,766	284	621	163	100	--	100	–
Coalinga	8,450	1,032	2,665	327	100	16	100	–
Bakersfield, CA Water	172,800	20,222	51,641	321	15	24	15	$263

Note:
af = Acre-feet.
mgd = Million gallons per day.
-- = Not available.

Source:
DWR 1994.

7.5.3.5 OTHER SWP AND CVP SERVICE AREAS

The Other SWP and CVP Service Areas include the service areas of all SWP entitlement holders in the central coast and south of Kern County. The single largest provider is The Metropolitan Water District of Southern California (MWD) in DWR's South Coast Region. The South Coast Region urban water demand exceeds the demands of all other urban regions combined. The South Coast Region includes Ventura, Los Angeles, and Orange Counties and the western portions of San Diego, Riverside, and San Bernardino Counties. The Other SWP and CVP Service Areas also include service areas receiving SWP water in DWR's Central Coast Region, the Antelope Valley and Mojave River Planning Subareas of the South Lahontan Region, and the Coachella Planning Subarea of the Colorado River Region. Central Coast SWP contractors are Santa Barbara County Flood Control and Water Conservation District and San Luis Obispo Flood Control and Water Conservation District. The Central Coast SWP contractors are served by deliveries through the Coastal Aqueduct of the SWP.

The single largest provider is The Metropolitan Water District of Southern California in DWR's South Coast Region. The South Coast Region urban water demand exceeds the demands of all other urban regions combined.

The historical population trend in portions of the Other SWP and CVP Service Areas from 1963 to 1990 and the projected population to year 2000 are shown in comparison to other regions in Figure 7.5-2. This figure shows population in DWR's Central Coast, South Coast, and South Lahontan Regions. This population increased from about 12.1 million in 1970 to 18.2 million in 1990, for an annual growth rate of 4.4%. The population growth rate slowed between 1990 and 1995.

Table 7.5-11 shows per capita water use in DWR's Central Coast, South Coast, and South Lahontan Regions in 1968, 1980, and 1990. Since 1970, per capita use in the South Coast Region has increased slightly, probably due to new residential development in the more inland, hotter portions of the region. Per capita use in the Central Coast Region has declined, probably due to high water prices and more intensive water conservation.

Table 7.5-11. Per Capita per Day Water Use, Other SWP and CVP Service Areas, 1968 to 1990 (gallons)

YEAR	ALL USES
South Coast Region	
1990	211
1980	191
1968	179
Central Coast Region	
1990	189
1980	210
1968	194
South Lahontan Region	
1990	278
1980	280
1968	305

Note:
DWR's hydrological regions defined in Bulletin 160-98.

DWR estimated that groundwater for urban use in the South Coast Region costs from $45 to $190 per acre-foot. There is little potential for new yield without intentional recharge or expensive treatment. DWR estimated an SWP unit water charge in the southern California area of $206 per acre-foot.

MWD recently developed an Integrated Resources Plan as a policy guideline for future resource and capital development. Development, treatment, and distribution costs of new Colorado River Aqueduct supplies are expected to cost about $250 per acre-foot; but the yield of these options is limited by the conveyance capacity of the Colorado River Aqueduct. Additional storage, low-cost transfers, and additional SWP supplies would cost around $300 per acre-foot; low-cost reclamation and high-cost transfers, about $400 per acre-foot; high-cost reclamation, about $600 per acre-foot; groundwater recovery about $700; and desalination would cost more than $1,400 per acre-foot.

Table 7.5-12 shows recent imports into the region through SWP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. SWP deliveries to MWD declined 72% from 1990 to 1991 and did not recover until 1993. Similar delivery patterns were experienced by the other SWP urban entitlement holders in the region.

Table 7.5-12. M&I Water Delivered to the Central Coast and South of Kern County by the SWP, 1990 to 1993 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993
State Water Project				
The Metropolitan Water District of Southern California	1,396,423	391,447	707,311	1,408,050
Other southern California	189,483	51,249	105,090	193,092
Total	**1,585,906**	**442,696**	**812,401**	**1,601,142**

Note:
Does not include water rights deliveries or water transfers.

Sources:
Reclamation 1996, DWR 1996.

DWR's Bulletin 160-98 estimated that the South Coast Region will experience a year 2020 supply deficit of 0.9 and 1.3 MAF in average and dry years, respectively, or enough to meet the demands of about 4.5 million persons in the average year. Most of this shortage could be eliminated with new supplies, especially reclaimed water and new yield from Colorado River, local and SWP improvements, and conservation. Nevertheless, a substantial supply deficit would remain.

DWR's Bulletin 160-98 estimated that the South Coast Region will experience a year 2020 supply deficit of 0.9 and 1.3 MAF in average and dry years, respectively, or enough to meet the demands of about 4.5 million persons in the average year.

Table 7.5-13 shows some characteristics of urban providers in the region. In the South Coast Region, only those providers delivering more than 10,000 million gallons (30.7 TAF) annually are included. Per capita use rates generally increase with distance from the coast. Most providers supply a mix of purchased and developed water, and almost all providers use a mix of surface water and groundwater supplies.

MWD's Integrated Resource Plan provides a Preferred Resource Mix for 2020, which includes 512 TAF annually of new conservation; 290 TAF of new water recycling; 40 TAF of groundwater recovery; dry-year yields of 220 and 400 TAF from existing reservoirs and the Eastside Reservoir, respectively; 200 TAF of dry-year yield from conjunctive use; about 700 TAF of additional dry-year SWP supplies; and 300 TAF of water transfers from willing sellers.

7.5.4 ASSESSMENT METHODS

Under CEQA, economic or social effects alone are not treated as a significant environmental impact. According to CEQA, the analysis can trace a chain of cause and effect from a proposed project through anticipated economic or social changes resulting from the project to physical changes caused in turn by the economic or social changes. The analysis should focus on the physical changes to the environment, and economic or social changes do not need to be analyzed in any detail greater than necessary to trace a chain of cause and effect. However, economic or social effects of a project can be used to determine the significance of physical changes caused by a project and should be considered (together with technological and environmental factors) in deciding whether changes in a project are feasible in order to reduce or avoid the significant effects on the environment identified in the EIR.

In the interest of full disclosure, the Program presents an overview of the concerns and possibilities that could affect urban water supply economics as Program elements are carried out. However, due to the programmatic nature of the document, only general information can be presented at this time; more specific information will be developed under second-tier, project-specific documentation.

Table 7.5-13. Characteristics of Some Providers in the Other SWP and CVP Service Areas

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Central Coast Region								
San Luis Obispo	41,958	1,560	12,350	102	0	100	59	$890
Goleta	70,480	1,934	13,750	75	76	100	75	$1,381
Santa Barbara	85,571	3,079	24,146	99	61	100	68	$1,364
South Coast Region*								
Carson et al.	101,000	12,667	31,611	344	73	100	73	–
Long Beach	429,433	24,448	87,923	156	65	100	65	$498
Los Angeles	3,485,398	218,809	635,698	172	73	100	89	$462
Glendale	180,038	10,144	32,778	154	93	100	93	$312
Pasadena	131,590	12,629	36,998	263	66	N/A	67	$331
Anaheim	266,406	24,064	55,500	247	49	100	49	–
Fullerton	114,144	10,584	27,890	254	54	100	54	–
Huntington Beach	181,519	12,530	48,571	189	53	100	53	–
Santa Ana	293,742	16,665	43,491	155	25	N/A	25	–
Riverside	226,505	22,217	66,348	269	8	100	8	$268
Ontario	133,179	12,101	28,019	249	46	100	46	–
Rancho Cucamonga	101,409	13,810	32,567	373	46	100	59	–
Fontana	75,000	10,411	28,000	380	100	100	30	–
Mission Viejo	109,250	10,700	37,445	268	100	100	100	–
El Cajon et al.	227,293	13,514	53,347	163	98	100	99	–
San Diego	1,100,549	73,927	235,810	184	100	100	100	$576
Chula Vista & vicinity	135,163	15,986	60,673	324	87	100	96	–
South Lahontan Region								
Palmdale	68,842	6,073	19,626	242	43	100	44	$488

Notes:
DWR's hydrological regions defined in Bulletin 160-98.
af = Acre-feet.
mgd = Million gallons per day.
– = Not available.

* Includes only those providers with 10,000 million gallons per year or more.

Source:
DWR 1994.

Urban water supply economics assessment variables include:

- Water supply benefits and costs
- Water quality benefits
- Water conservation benefits and costs

Water Supply. The urban water supply economics assessment uses preliminary results from DWRSIM and two models of urban water supply economics to estimate the gross benefits of new Program water supplies under 2020 conditions. Water supply benefits are any cost savings on water supplies needed to meet future demands and cost savings on avoided shortage costs.

DWR has provided a preliminary least-cost planning analysis for the South Coast and Bay Regions using a Least-Cost Planning Simulation Model (LCPSIM). The analysis uses a system simulation framework to evaluate the value of imported water. The analysis calculates the percentage of local fixed yield that is no longer cost effective under Program water delivery scenarios. The analysis considers the marginal trade-off between the increment of supply made available by Program alternatives and the regional fixed-yield options that would be built under the No Action Alternative. The analysis also incorporates opportunities for conjunctive use and for shortage contingency water transfers. This analysis assumed that local planners would incorporate least-cost planning principles as part of their decision criteria. Water demands are based on DWR's Bulletin 160-98 2020 levels. The simulation model is described in detail in Section 7.5.15.

DWR will be providing a preliminary least-cost planning analysis for the South Coast Region. For the remainder of the state, simple models of municipal water costs tailored to each of eight regions have been applied.

Simple models of municipal water costs tailored to each of eight regions also are used. The eight regions are the Redding area, Sacramento area, CCWD, North Bay, South Bay, San Joaquin Valley CVP contractors, San Joaquin Valley SWP contractors, and the South Coast and South Lahontan Regions.

These regions are combined into five regions for this presentation: CCWD, the rest of the Bay Region, the Sacramento Valley, the San Joaquin Valley, and the South Coast/South Lahontan Region. The models provide some information for potentially affected urban water supplies outside the Bay and South Coast Regions. They are used to display No Action Alternative and existing conditions for these regions and provide a basis for comparison with DWRs LCPSIM.

The M&I models methodology is explained in the CVPIA Municipal Water Costs Methodology/Modeling Technical Appendix. Water demands are based on DWR's Bulletin 160-98 2020 levels. The analysis uses demand and supply functions to estimate water shortage and supply costs. Long-run and short-run demand elasticity is equal to -0.20 and -0.10, respectively.

Because of the programmatic nature of this document, the level of detail used for the analysis is necessarily preliminary in nature. Although the methods and principles described above result in dollar values, substantial uncertainty is associated with these values.

Several important assumptions were made for this urban water supply analysis, including the following:

- No water transfers from the Central Valley were included as alternative supplies, except in the South Coast analysis provided by DWR, where 400 TAF are allowed.

Important assumptions made for this urban water supply analysis include: No water transfers from the Central Valley are included as alternative supplies, except in the South Coast, where 400 TAF are allowed. Water supply deliveries from DWRSIM Run 675 are the No Action Alternative condition used to evaluate the change in water supply due to Program alternatives.

This constraint tends to increase the value of new water relative to existing and actual future conditions because water transfers have recently been, and should continue to be, a low-cost source of supplies.

The DWRSIM preliminary runs used in the analysis, the corresponding alternatives, and the increase in average deliveries are shown in Table 7.5-14. Each alternative was simulated with and without new storage and, to consider uncertainty, each of these simulations were further modeled under two water management criteria. Criterion A includes current Bay-Delta system demands. Any future increase in demands would be met by alternative supply or demand management options. Also, CVP and SWP facilities are operated to meet additional prescriptive Delta actions above existing conditions. Criterion B assumes a future increase of about 10% in system demands, and only existing prescriptive Delta actions are required.

Table 7.5-14. Increase in Average Water Deliveries to Urban Water Users by Water Management Criteria, Storage, and Allocation Scenario for Program Alternatives and Two Urban Regions, Compared to the No Action Alternative (TAF)

	CRITERION A				CRITERION B			
	NO STORAGE		WITH STORAGE		NO STORAGE		WITH STORAGE	
	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Alternative 1 (Preferred Program Alternative without pilot facility near Hood)								
Bay Region average incremental supply (TAF)	5.4	8.7	25.7	36.3	5.2	13.1	18.8	38.3
South Coast average incremental supply (TAF)	9.7	22.0	80.2	118.0	31.0	84.9	118.7	266.1
Preferred Program Alternative with pilot facility near Hood								
Bay Region average incremental supply (TAF)	4.8	8.8	40.4	44.2	5.2	13.5	18.9	38.4
South Coast average incremental supply (TAF)	10.1	24.3	129.6	144.8	31.6	88.0	118.9	267.3
Alternative 2								
Bay Region average incremental supply (TAF)	5.0	9.5	24.9	35.1	7.4	18.2	24.3	41.1
South Coast average incremental supply (TAF)	10.2	24.8	77.9	114.2	43.2	121.5	161.8	288.4
Alternative 3								
Bay Region average incremental supply (TAF)	3.3	5.0	22.8	31.2	4.8	12.7	20.1	37.5
South Coast average incremental supply (TAF)	6.0	13.0	72.7	101.9	28.9	81.9	129.5	259.4

Notes:
TAF = Thousand acre-feet.

Incremental changes in water exports have been allocated among water users, according to two alternative water allocation assumptions. In the "low priority" allocation, urban users have priority to 20% of new supplies before agricultural users obtain any. In the "high priority" allocation, urban users have a priority to 80% of new supplies.

The M&I models are different from the LCPSIM in the manner in which Water Use Efficiency Program actions are handled. The LCPSIM uses Bulletin 160-98 baseline information on local supplies. Given the amount of surface water available in each alternative, the LCPSIM then determines how much conservation and recycling are needed to meet demand. The amounts of conservation and recycling can then be compared to Program to Water Use Efficiency Program water savings to see if program goals were met. The M&I models, on the other hand, use the Water Use Efficiency Program savings in the baseline supplies for each alternative and then determine how much of the new surface water supplies should be used to meet demand.

Limited information on the costs of Program alternatives is used in the analysis. A comparison of all benefits and costs would require estimates of benefits increasing over time with population and economic growth. Since only 2020 conditions are considered, no judgment can or should be made about the potential benefit-cost relations of the Program alternatives.

Water Quality. Water quality constituents that are important to urban water users include salinity (including bromide), organic carbon, and resultant DBPs formed during treatment; turbidity; a large number of man-made chemicals; and microbes. Water quality of urban supplies is affected by the quality of source waters, but changes in quantities of supplies are also important when a provider uses multiple supplies that vary in their quality. Some providers intentionally mix supplies of various qualities to attain their water quality goals.

Water quality of urban supplies is affected by the quality of source waters, but changes in quantities of supplies are also important when a provider uses multiple supplies that vary in their quality. Some providers intentionally mix supplies of various qualities to attain their water quality goals.

Water quality and related water treatment costs could be affected by the Water Quality, Ecosystem Restoration, Watershed, Storage, and Conveyance Elements. Quantitative analysis of water quality changes is available only for the Conveyance Element, and quantitative economic analysis is possible only for salinity. Therefore, a comprehensive analysis of costs and benefits is not possible.

A preliminary economic analysis of salinity damages in Delta export water users' service areas was conducted for some Program conveyance alternatives. The economic analysis of salinity considered quality and quantity. DWR provided estimates of end-of-month salinity at CCFB and Rock Slough for the water years 1976-91 for the Preferred Program Alternative and Alternatives 1, 2, and 3. The salinity data accounted only for differences in salinity caused by the different geometry of conveyance and intake configurations. The data did not account for any differences caused by different export amounts, storage configurations, or the timing of exports or storage releases.

A preliminary economic analysis of salinity damages in Delta export water users' service areas was conducted for some Program conveyance alternatives. The economic analysis of salinity considered quality and quantity. Results showed that economic benefits of Program alternatives depend significantly on baseline water quality levels within service areas.

Water quality costs of these changes in salinity were estimated using an economic model of salinity costs. The model was based on an earlier model of salinity damages for the entire lower Colorado River basin. The revised model, obtained from MWD, included all of the data required to run the model for the South Coast Region and none of the data needed for the other regions included in the analysis. The model obtained from MWD with data for the South Coast Region was altered to consider the Program alternatives in terms of the quantity and salinity of SWP supplies for that region.

The model was configured to accept data for five other potentially affected regions: the South Lahontan, CCWD, the South Bay, the San Joaquin Valley, and the Central Coast. Bulletin 160-93 data were used to develop certain data on demands and quantity of other (non-Delta) supplies. A survey of potentially affected providers was conducted; and their responses provided useful information on demands, supplies, and salinity.

Results showed that economic benefits of Program alternatives depend significantly on baseline water quality levels within service areas. These levels may be substantially affected by actions between now and 2020, such as development of recycling capacity, implementation of RO, and adoption of water softeners. Economic results are especially sensitive to the amount of RO capacity in place in 2020.

New salinity and bromide data have been developed. A summary of the new salinity data is provided in Table 7.5-15. Bromide concentrations are highly correlated to the salinity data.

Water Conservation. The Revised Water Use Efficiency Program Plan provides general and specific state-wide assumptions, estimates of urban water use, and preliminary estimates of existing and future urban water conservation savings with and without the Water Use Efficiency Program. In practice, each urban water provider would implement conservation measures that are most economically feasible as part of their water supply and demand solutions.

Water conservation benefits are primarily raw water cost savings. Economic savings also may include treatment and delivery costs, end-user energy costs, and wastewater treatment cost savings. Water conservation costs include program costs, lost water revenues, and end-user costs. Utilities pay the program costs of conservation programs, and they loose net revenues from water sales. End-users pay some additional costs for compliance with mandatory and voluntary provisions (for example, the costs of water-saving devices, time, and inconvenience). If end-users are forced to conserve, they may loose what they were willing to pay for the water above its price.

Utilities pay the program costs of conservation programs, and they loose net revenues from water sales. End-users pay some additional costs for compliance with mandatory and voluntary provisions (for example, the costs of water-saving devices, time, and inconvenience).

Total urban water conservation potential is estimated under the 2020 No Action Alternative at 620-750 TAF of depletion reduction in seven regions of the state (Table 7.5-16). This level of conservation is slightly more than the amount assumed to be implemented in Bulletin 160-98. With the Program Water Use Efficiency Program, an additional 780-910 TAF are expected to be conserved. The Program might provide up to $30 million annually to support urban and agricultural water conservation efforts. About two-thirds of this total would be expended for grants and contracts with local agencies to support implementation.

Table 7.5-15. Change and Percent Change in Conductivity of Water for Four Alternatives in Comparison to the No Action Alternative for All Water-Year Types and Dry and Critical Years, at Select Locations

	DIFFERENCE IN CONDUCTIVITY UNITS				PERCENT CHANGE				
	CRITERION A NO STORAGE		CRITERION B WITH STORAGE		CRITERION A NO STORAGE		CRITERION B WITH STORAGE		
	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	CONCLUSION
Difference Between No Action Alternative and Preferred Program Alternative									
All water-year types									
NBA intake at Barker Slough	0	0	0	0	0.0%	0.0%	0.0%	0.0%	
CCC intake at Rock Slough	-20	-250	-140	-470	-3.0%	-21.0%	-22.0%	-40.0%	Beneficial
Old River at SR 4	-30	-250	-130	-440	-5.0%	-23.0%	-23.0%	-42.0%	Beneficial
Clifton Court Forebay	-10	-200	-110	-370	-2.0%	-20.0%	-21.0%	-39.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	0	0	-10	-10	0.0%	0.0%	-5.0%	-4.0%	
CCC intake at Rock Slough	-30	-300	-180	-590	-4.0%	-21.0%	-25.0%	-43.0%	Beneficial
Old River at SR 4	-40	-310	-460	-560	-6.0%	-24.0%	-49.0%	-45.0%	Beneficial
Clifton Court Forebay	-20	-230	-140	-450	-3.0%	-20.0%	-23.0%	-41.0%	Beneficial
Difference Between No Action Alternative and Alternative 1									
All water-year types									
NBA intake at Barker Slough	0	0	0	-10	0.0%	0.0%	0.0%	-3.0%	
CCC intake at Rock Slough	20	40	70	130	3.0%	3.0%	11.0%	11.0%	Potential [1]
Old River at SR 4	10	30	60	100	2.0%	3.0%	11.0%	9.0%	Potential [1]
Clifton Court Forebay	30	70	70	140	5.0%	7.0%	13.0%	15.0%	Potential [1]
Dry and critical years									
NBA intake at Barker Slough	0	0	-10	-10	0.0%	0.0%	5.0%	4.0%	
CCC intake at Rock Slough	30	70	100	180	4.0%	5.0%	14.0%	13.0%	Significant
Old River at SR 4	20	50	-210	140	3.0%	4.0%	-22.0%	11.0%	Significant
Clifton Court Forebay	40	90	100	270	6.0%	8.0%	16.0%	25.0%	Significant
Difference Between No Action Alternative and Alternative 2									
All water-year types									
NBA intake at Barker Slough	0	10	0	-50	0.0%	3.0%	0.0%	-15.0%	Beneficial
CCC intake at Rock Slough	-180	-590	-270	-760	-28.0%	-49.0%	-43.0%	-65.0%	Beneficial
Old River at SR 4	-160	-550	-230	-700	-27.0%	-51.0%	-41.0%	-66.0%	Beneficial
Clifton Court Forebay	-140	-470	-180	-560	-25.0%	-48.0%	-34.0%	-59.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	0	10	10	-40	0.0%	4.0%	5.0%	-16.0%	Beneficial
CCC intake at Rock Slough	-220	-720	-330	-920	-29.0%	-51.0%	-46.0%	-68.0%	Beneficial
Old River at SR 4	-200	-670	-590	-840	-29.0%	-52.0%	-62.0%	-68.0%	Beneficial
Clifton Court Forebay	-170	-560	-220	-660	-25.0%	-48.0%	-35.0%	-60.0%	Beneficial
Difference Between No Action Alternative and Alternative 3									
All water-year types									
NBA intake at Barker Slough	10	-40	0	-40	4.0%	-12.0%	0.0%	-12.0%	Beneficial
CCC intake at Rock Slough	-90	-590	-50	-320	-14.0%	-49.0%	-8.0%	-27.0%	Beneficial
Old River at SR 4	0	-420	-30	-280	0.0%	-39.0%	-5.0%	-26.0%	Beneficial
Clifton Court Forebay	-420	-830	-380	-800	-74.0%	-85.0%	-71.0%	-84.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	10	-40	-10	-10	5.0%	-16.0%	-5.0%	-4.0%	Beneficial
CCC intake at Rock Slough	-120	-780	-60	-420	-16.0%	-55.0%	-8.0%	-31.0%	Beneficial
Old River at SR 4	0	-570	-40	-360	0.0%	-44.0%	-6.0%	-29.0%	Beneficial
Clifton Court Forebay	-530	-980	-470	-940	-78.0%	-87.0%	-76.0%	-86.0%	Beneficial

Notes:
[1] Potentially significant adverse effect.
CCD = Contra Costa Canal.
NBA = North Bay Aqueduct.
SR = State Route.

Source:
CALFED Administrative Draft Programmatic EIS/EIR, April 1998, Section 5.3, "Water Quality."

Table 7.5-16. Reuse and Urban Conservation in Bulletin 160-98, the No Action Alternative, and the Water Use Efficiency Program (TAF)

	BULLETIN 160-98 INCLUDES:		NO ACTION ALTERNATIVE LEVELS OF:		WATER USE EFFICIENCY, ADDITIONAL:	
REGION[1]	**REUSE**	**URBAN CONSERVATION**[2]	**REUSE**	**URBAN CONSERVATION**[2]	**REUSE**	**URBAN CONSERVATION**[2]
Bay Region	37	172	53	100-120	50-170	155-180
Central Coast Region	34	30	35	20-40	30-70	40-60
South Coast Region	273	500	392	450-495	350-810	510-555
Sacramento Valley Region	0	0	0	5-10	0	5-10
San Joaquin Valley Region	0	30	0	3-8	0	7-12
Tulare Region	0	50	0	20-35	0	35-50
Colorado River Region	15	52	15	20-40	0	25-45
Total	**386**	**855**	**480**	**620-750**	**430-1,050**	**780-910**

[1] These hydrologic regions are used in DWR's Bulletin 160-98.
[2] Urban conservation is irrecoverable loss savings.

The Water Use Efficiency Program also includes urban water reuse. The Program would encourage cost-effective reuse actions with financial and technical assistance. Benefits are primarily water supply cost savings, but reduced regulatory costs, especially in the Bay Region, are possible. Total recycling potential under the No Action Alternative is estimated at 480 TAF of new supply, including existing reuse. This level of reuse is more than the amount included in Bulletin 160-98. With the Program, an additional 430-1,050 TAF of recycled water can be produced, with about 25% less made available as new supply. The Program might provide $25-$30 million annually to support recycling efforts.

Water Use Efficiency Program also includes urban water reuse. The Program would encourage cost-effective reuse actions with financial and technical assistance. Benefits are primarily water supply cost savings, but reduced regulatory costs, especially in the Bay Region, are possible.

The assessment of urban water use efficiency economics is largely qualitative because reliable quantitative information on the costs of water conservation is not available. This is especially true because the impact of the Program is above and beyond conservation under the No Action Alternative anticipated to 2020. Because the No Action Alternative levels are being planned for now, some baseline cost information is available. Costs of baseline savings are estimated to range between $400 and $1,600 per acre-foot per year. The Program increment involves conservation and reuse beyond current practical experience. Costs of recycling for the Program increment have been estimated to range between $1,000 and $2,000 per acre-foot per year.

7.5.5 CRITERIA FOR DETERMINING ADVERSE EFFECTS

Economic effects are categorized as either adverse or beneficial. A net economic effect is considered adverse if its costs are expected to be larger than its benefits, and a net effect is considered beneficial if its benefits exceed its costs. No complete estimates of benefits or costs are available for the Program alternatives. Therefore, net effects cannot be judged. For this analysis, a substantial increase in water supply is considered beneficial. This does not imply that the net benefit is positive, that benefits exceed costs, or that the costs are less than alternative sources of supply.

An economic effect is considered adverse if its costs are expected to be larger than its benefits, and an effect is considered beneficial if its benefits exceed its costs. No complete estimates of benefits or costs are available for the Program alternatives. Therefore, net effects cannot be judged.

For water quality impacts, a reduction in TDS of Delta export water is considered beneficial if it is more than 10% of the concentration under the No Action Alternative and adverse if the increase in TDS is more than 10% of the concentration under the No Action Alternative. Impacts on DBP precursors are considered potentially significant if the change is approximately 10% or more of levels under the No Action Alternative.

7.5.6 NO ACTION ALTERNATIVE

The No Action Alternative displays the state of water supply economics for a 2020 level of development as opposed to the existing (1995) conditions. The 2020 level of development is expected to result in a substantial increase in demand for urban water because of the increase in population and urban water use over time. Average water supply under the No Action Alternative condition exceeds that of existing conditions simply because the demand put on supply is more.

Under existing conditions, Delta conveyance or pumping capacity sometimes limits exports. At other times, water is available in the Delta and excess pumping capacity exists, but no immediate demand or storage space is available to utilize the water. New south-of-Delta storage and conveyance projects built between now and 2020 will reduce the current export constraints.

This increase in supply may not come from the Delta, however, and the increased demand may be minimized by conservation and local reuse. To consider uncertainty in future water demand and supply, the Program water supply modeling has included two sets of alternative water management criteria.

Table 7.15-17 shows characteristics of urban provider groups for existing conditions and the No Action Alternative. Water prices, costs, and estimates of 2020 demands were obtained from DWR's Bulletin 160-98, Program data, and information furnished by urban water providers. Local water supplies are based on information from Bulletin 160-98 and Program data. For the analysis, water demands are reduced for additional conservation under the No Action Alternative, and water supplies have been increased to account for water recycling levels under the No Action Alternative.

7.5.6.1 DELTA REGION

For this analysis of water supply changes, economic impacts in CCWD are used to represent economic impacts of the Program alternatives in the Delta Region. The primary reason for this assumption is that urban water supplies for most other providers in the Delta would not be affected by the Program alternatives in ways that can be measured at this time. In the following discussion, the term "Delta providers" is reserved for any and all providers actually located within the Delta.

For this analysis of water supply changes, economic impacts in CCWD are used to represent economic impacts of the Program alternatives in the Delta Region.

Table 7.5-17 shows some characteristics of CCWD for existing conditions and the No Action Alternative. Current demand is about 160 TAF, which includes 10 TAF of direct diversions by industrial customers. Retail cost to residential customers is currently about $900 per acre-foot. Price, which does not include service charges, is about $600 per acre-foot. About one-third of demand is commercial and industrial. Demand is expected to rise to 205 TAF by 2020, with slightly higher demands in dry years due to less natural precipitation and subsequent recharge of urban landscapes.

The No Action Alternative retail cost and price are higher than those for existing conditions because of conservation, CVPIA costs, and costs of new supplies. There is a small average condition supply deficit that costs from $600 to $700 per acre-foot of new supply to eliminate. Additional shortage during drought is expected to cost from $900 to $1,000 per acre-foot to eliminate. (This estimate assumes that new water transfers are not available for CCWD.)

The No Action Alternative retail cost and price are higher than those for existing conditions because of conservation, CVPIA costs, and costs of new supplies.

No Action Alternative projects that may reduce urban supplies or that may increase costs relative to existing conditions include the CVPIA dedication of 800 TAF of water for fish and wildlife and Level 4 refuge supplies, which will reduce CCWD water supplies relative to existing conditions. The CVPIA also will affect other Delta providers, including the City of Tracy and potentially parts of Stockton and Sacramento. No Action Alternative projects that are expected to increase supplies or reduce future costs include the Los Vaqueros Reservoir Project. This project improves the quality and reliability of CCWD supplies.

Other Delta providers (not CCWD) generally are provided by larger water wholesalers, small districts, or individual wells. No specific actions have been identified that will affect these providers. However, these small providers typically have plans and programs in place that will affect their future water supplies.

Table 7.5-17. Characteristics of M&I Providers by Program Region under Existing Conditions and the No Action Alternative

CONDITION VARIABLE	DELTA REGION (CCWD)[a]	BAY REGION[b]	SACRAMENTO RIVER REGION	SAN JOAQUIN RIVER REGION	OTHER SWP AND CVP SERVICE AREAS
Existing Conditions					
TAF average demand	160	707	566	337	3,784
TAF dry-year demand	160	767	613	344	3,916
Typical retail cost, $/AF[c]	$900	$500-700	$100-300	$250-350	$450-1,350
Typical retail price, $/AF	$600	$500-700	$0-300	$100-350	$350-1,250
Percent industrial and commercial	31%	31%	41%	48%	26%
No Action Alternative (Criterion B)					
TAF average demand	205	808	823	736	6,597
TAF average shortage	28	0	0	51	789
TAF dry-year demand	205	897	896	744	6,704
Typical retail cost, $/AF[c]	$900	$575-800	$125-325	$275-400	$500-1,450
Typical retail price, $/AF	$600	$500-700	$0-350	$125-175	$420-1,350
Percent industrial and commercial	31%	31%	41%	48%	26%
Average cost of supplies[d]	$600-700	N/A	N/A	$150-250	$500-600
TAF shortage during drought[e]	19	193	9	55	405
Mandatory conservation during drought	11	45	9	33	405
TAF supplies developed during drought	8	148	0	22	0
Average cost of drought shortage, $/AF	$900-1,000	$600-700	$100-350	$150-350	$900-2,000

Notes:
AF = Acre-feet.
CCWD = Contra Costa Water District
N/A = Not applicable.
TAF = Thousand acre-feet.

[a] Includes major industrial direct diversions of 10 TAF per year.
[b] Not Contra Costa Water District, East Bay Municipal Utility District, or Marin County.
[c] Average cost for residential customers, including service charges. Costs and prices for providers with only CVP water are typically higher.
[d] Average cost of new supplies per acre-foot needed to achieve supply/demand balance under No Action Alternative average condition.
[e] After adjusting for long-run average supplies and demand.

Sources:
DWR 1998, CALFED 1999.

7.5.6.2 BAY REGION

Table 7.5-17 shows some characteristics of the Bay Region for existing conditions and the No Action Alternative. Current demand is about 707 TAF. Retail cost to residential customers is currently about $500-$700 per acre-foot; and price, which does not include service charges, is about the same. About one-third of demand is commercial and industrial.

Demand is expected to rise to 808 TAF by 2020, with slightly higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation, CVPIA restoration charge costs, and costs of new supplies. The region has a slight supply surplus in the average condition. The Bay Region has relatively unreliable supplies, resulting in a substantial supply deficit in the dry condition. This deficit is expected to cost from $600 to $700 per acre-foot to eliminate.

The No Action Alternative cost and price are higher than those for existing conditions because of conservation, CVPIA restoration charge costs, and costs of new supplies. The Bay Region has relatively unreliable supplies, resulting in a substantial supply deficit in the dry condition.

The Bay Region is affected by any actions that affect the SWP or the CVP. No Action Alternative projects that may reduce urban supplies or increase costs relative to existing conditions include the CVPIA, which may reduce CVP supplies and increase costs for the reasons described under the Delta Region. No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include the CVPIA dedicated water. Dedicated water may increase SWP supplies depending on the amount of dedicated water that can be exported from the Delta.

7.5.6.3 SACRAMENTO RIVER REGION

Table 7.5-17 shows some characteristics of the Sacramento River Region for existing conditions and the No Action Alternative. The 1990 level of demand was about 566 TAF. Retail cost to residential customers is about $100-$300 per acre-foot. Variable price, which does not include service charges, is $0-$300 per acre-foot. This price is zero in some areas because some use is not metered or priced volumetrically. About 40% of demand is commercial and industrial.

Demand is expected to rise to 823 TAF by 2020, with higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA restoration charge costs.

The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA restoration charge costs.

No Action Alternative projects that may reduce urban supplies or increase costs relative to existing conditions include CVPIA dedicated water, which may reduce CVP supplies and increase costs for the reasons described under the Delta Region; and interim reoperation of Folsom Reservoir, which could reduce urban water supplies in the Sacramento area by dedicating more storage space to flood control.

7.5.6.4 San Joaquin River Region

Table 7.5-17 shows some characteristics of the San Joaquin River Region for existing conditions and the No Action Alternative. Current demand is about 337 TAF. Retail cost to residential customers is currently about $250-$350 per acre-foot. Price, which does not include service charges, is $100-$350 per acre-foot. About one-half of demand is commercial and industrial.

Demand is expected to double to 736 TAF by 2020, with higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA costs.

The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA costs.

No Action Alternative projects that may reduce urban supplies or increase costs relative to existing conditions include CVPIA dedicated water, which may reduce CVP supplies and increase costs for the reasons described above.

No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include:

- *Monterey Agreement* - This project revises the formula used to allocate SWP water, retires 45 TAF of agricultural entitlement, allows transfers of 130 TAF of entitlement from agriculture to urban use, and allows sale of the Kern Fan element of the Kern Water Bank to agricultural contractors.

- *CVPIA* - The CVPIA may increase SWP supplies for the reasons described under the Bay Region.

- *New Melones Conveyance Project* - This project conveys water to Stockton East Water District and Central San Joaquin Water Conservation District for use near and within Stockton.

7.5.6.5 Other SWP and CVP Service Areas

Table 7.5-17 shows some characteristics of the Other SWP and CVP Service Areas for existing conditions and the No Action Alternative. For urban economics, this region does not include any areas served by the CVP. The San Felipe Division of the CVP is included in the Bay Region.[1]

Demand is about 3,784 TAF in average years. Retail cost to residential customers is about $450-$1,350 per acre-foot. The higher price is representative only of the Central Coast

[1] Economic analyses were developed on a county-wide basis not by Program region; therefore, in the economic analyses, the San Felipe Division is included in the Bay Region rather than under Other SWP and CVP Service Areas.

area. Price, which does not include service charges, is about $350-$1,250 per acre-foot. About one-quarter of demand is commercial and industrial.

The 2020 demand would rise to 6,597 TAF in average years. Demands are higher in dry years due to less recharge of urban landscapes. Without new supplies, the region is expected to experience a substantial water supply deficit by 2020, even during average years. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and costs of new supplies.

Without new supplies, the region is expected to experience a substantial water supply deficit by 2020, even during average years. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and costs of new supplies.

No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include:

- *CVPIA* - The CVPIA may increase SWP supplies, depending on the amount of dedicated water that can be exported out of the Delta.
- *Coastal Aqueduct* - This project will provide SWP water for urban use in San Luis Obispo and Santa Barbara Counties.
- *Monterey Agreement* - The Monterey Agreement will change SWP water allocations for urban use, for the reasons described above and because allowable operations at Castaic Lake and Lake Perris will change.
- *Eastside Reservoir Project* - The MWD's Eastside Reservoir Project will provide emergency storage following an earthquake, supplies during drought, and supplies to meet peak summer demands.
- *Semitropic Water Storage District Groundwater Banking Project* - This project will allow certain SWP entitlement holders to recharge and extract SWP water in the Semitropic Water Storage District, and will reduce overdraft and increase operational flexibility.

7.5.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For urban water supply economics resources, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Program elements are similar under all Program alternatives, as described below. The environmental consequences of the Storage and Conveyance elements vary among Program alternatives, as described in Section 7.5.8.

7.5.7.1 DELTA REGION

Ecosystem Restoration Program

Ecosystem restoration actions are expected to result in small effects on urban water supplies and costs, unless environmental flows reduce urban supplies or urban providers pay a substantial share of the costs of restoration. Water flows for fish and wildlife could increase urban water supply if: (1) the water can be reused as urban water exports, or (2) the flows contribute to Delta water quality standards. Prices of water transfers may be increased by dedication of water for environmental purposes.

Ecosystem restoration actions are expected to result in small effects on urban water supplies and costs, unless environmental flows reduce urban supplies or urban providers pay a substantial share of the costs of restoration.

Some restoration actions may beneficially affect water quality in the Delta. Water quality improvements may occur through dilution caused by increased Delta inflow for restoration purposes, through reduced pollution loads caused by development and restoration of marsh and riparian habitats. Some water quality improvements also may occur by increased immobilization of pollutants in these habitat types, but this benefit is undetermined. The opposite effect could occur during construction but would be short term. Other water quality impacts may be negative; for example, habitat restoration could increase organic carbon loads in Delta water, which would increase DBP levels in treated waters. These potentially significant impacts may or may not be able to be mitigated to less-than-significant levels. (Refer to Section 5.3 for more information about water quality impacts and mitigation strategies.)

Restoration may reduce the uncertainty of urban water supplies by enhancing the recovery of special-status species. Water supply costs could be reduced because urban providers acquire water supplies to protect against uncertainty and this uncertainty could be reduced by general species recovery.

Restoration may reduce the uncertainty of urban water supplies by enhancing the recovery of special-status species. Water supply costs could be reduced because urban providers acquire water supplies to protect against uncertainty and this uncertainty could be reduced by general species recovery.

Water Quality Program

The Water Quality Program could benefit urban water suppliers and users by improved water quality and lower treatment costs.

The Water Quality Program Plan Appendix details Water Quality Program actions, but no dollar cost estimates have been provided. Cost allocation issues for this program also have not been resolved. The cost of the Water Quality Program is considered an adverse economic effect.

The cost of relocating Tracy's wastewater treatment plant discharge is considered an adverse effect. However, the magnitude of this cost is not currently known.

The Water Quality Program could benefit urban water suppliers and users by improved water quality and lower treatment costs.

Levee System Integrity Program

Benefits of the Levee System Integrity Program include less risk of export interruptions caused by levee failure. The Long-Term Levee Protection Plan could be implemented over a 30-year period and would cost about $1.5 billion dollars. Costs include efforts to reach and maintain PL 84-99 standards ($1 billion) and implement Special Improvement Projects ($360 million). Currently, cost allocations are not known. Levee System Integrity Program actions would result in less-than-significant impacts on Delta hydraulics and water quality. Very small economic effects on water supply and quality, and associated costs are expected in normal conditions.

Benefits of the Levee System Integrity Program include less risk of export interruptions caused by levee failure.

Water Use Efficiency Program

Table 7.5-16 shows amounts of new water conservation and new re-use associated with the Water Use Efficiency Program. The cost of these actions could range from $500 to $1,000 per acre-foot annually.

Water Transfer Program

The Water Transfer Program does not advocate any particular transfers, and no estimate of cost is possible at this time. Water supply, supply costs, and water quality could be affected by water transfers. The availability of water transfers might affect selection of local supplies and other imported supplies. Water transfers may facilitate urban land use and development where water supply constraints otherwise would limit growth.

Water transfers may facilitate urban land use and development where water supply constraints otherwise would limit growth.

Watershed Program

Because no cost or cost-sharing information is currently available, effects associated with urban water supply economics cannot be determined.

7.5.7.2 BAY REGION

Ecosystem Restoration Program

Effects associated with the Ecosystem Restoration Program that are related to urban water supply economics in the Bay Region would be similar to those described for the Delta Region.

Water Quality Program

Economic effects associated with the Water Quality Program in the Bay Region would be similar to those described for the Delta Region. The program could include relocation of the NBA intake to the Colusa-Tehama Canal or to Miner Slough. No monetary benefits or costs have been estimated.

Levee System Integrity Program

Economic effects associated with the Levee System Integrity Program in the Bay Region, including the Suisun Marsh, would be limited to those related to cost sharing and Delta export supplies.

Water Use Efficiency Program

The nature and pattern of impacts related to urban water supply in the Bay Region that are associated with Water Use Efficiency actions would be the same as those described for the Delta Region. Because the Bay Region generally has a high level of conservation, additional costs of conservation per unit of water saved may be higher than average. Amounts of new water conservation and new reuse are shown in Table 7.5-16. The costs of these actions could range from $500 to $1,000 per acre-foot per year.

Because the Bay Region generally has a high level of conservation, additional costs of conservation per unit of water saved may be higher than average.

Water Transfer Program

Economic effects of water transfers in the Bay Region would be similar to those described for the Delta Region. The Bay Area would be affected by transfers primarily as a buyer of water. Effects cannot be determined with available information.

The Bay Area would be affected by transfers primarily as a buyer of water.

Watershed Program

Impacts in the Bay Region associated with watershed activities would be similar to those described for the Delta Region. Impacts cannot be determined with available information.

7.5.7.3 SACRAMENTO RIVER REGION

Ecosystem Restoration and Water Quality Programs

The Ecosystem Restoration and Water Quality Programs would not affect urban water economics in the Sacramento River Region, except as water supply amounts, costs of water, and land use may be affected.

Levee System Integrity Program

Impacts associated with the Levee System Integrity Program in the Sacramento River Region would be limited to those related to cost sharing and costs of water.

Water Use Efficiency Program

The nature and pattern of impacts in the Sacramento River Region that are associated with Water Use Efficiency actions would be similar to those described for the Delta Region. Because the Sacramento River Region generally has a low level of conservation under existing conditions, additional costs of conservation per unit of water saved may be lower than average. Real water savings from conservation or reuse may be minimal because of this region's location upstream of the Delta. However, conservation can reduce costs of new infrastructure and treatment, and reduced water diversions could provide ecosystem flow and water quality benefits.

Because the Sacramento River Region generally has a low level of conservation under existing conditions, additional costs of conservation per unit of water saved may be lower than average. Real water savings from conservation or reuse may be minimal because of this region's location upstream of the Delta.

Water Transfer Program

The nature and pattern of impacts in the Sacramento River Region associated with water transfers would be similar to those described for the Delta Region.

Watershed Program

Impacts in the Sacramento River Region associated with watershed actions would be similar to those described for the Delta Region. Land use effects could have minimal influence on the cost of urban water supplies.

7.5.7.4 SAN JOAQUIN RIVER REGION

Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, and Watershed Programs

The nature and pattern of impacts in the San Joaquin River Region would be the same as those described for the Delta Region.

Water Transfer Program

The nature and pattern of impacts in the San Joaquin River Region associated with water transfers would be same as those described for the Delta Region, except that water transfers could affect the amount of water exported from the Delta.

7.5.7.5 OTHER SWP AND CVP SERVICE AREAS

All Programs

The nature and pattern of economic effects associated with Program elements in the Other SWP and CVP Service Areas would be similar to those described for the Bay Region. Cost effects should be greater in magnitude but about the same relative to population size.

Cost effects should be greater in magnitude but about the same relative to population size.

7.5.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

Storage differs in this analysis not in the physical impacts but in the amount of water than can be transported through the Delta, depending on conveyance features.

For urban water supply economics, the Storage and Conveyance elements differ among the alternatives because the conveyance component differs. Although the range of storage is the same for all Program alternatives, storage differs in this analysis not in the physical impacts but in the amount of water than can be transported through the Delta, depending on conveyance features.

7.5.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes description of the consequences of a pilot diversion project. If the project is not built, these consequences would not be associated with the Preferred Program Alternative.

Delta Region

Storage and Conveyance features and improvements are expected to result in a beneficial effect on water supply economics for CVP water providers located in the Delta, primarily parts of CCWD. Benefits involve water quality as well as quantity. Most quality improvements are related to conveyance, and most quantity improvements are tied to storage. The significance of these impacts will depend on the amount of storage. The relative size of impacts on individual providers depends on the share of the new water supplies as part of their entire water supply mix.

Benefits involve water quality as well as quantity. Most quality improvements are related to convey-ance, and most quantity improve-ments are tied to storage.

On the other hand, Storage and Conveyance costs are expected to result in an adverse effect on water supply economics. The amount of adverse effects from the Preferred Program Alternative will depend on how costs are allocated. No information currently is available to determine allocation of costs between uses. No information has been developed that would allow water supply benefits to be compared to costs. Cost allocation and repayment requirements will be developed in the staged implementation phase of the Preferred Program Alternative.

Storage and conveyance cost repayment is expected to result in an adverse effect on water supply economics.

Water supply effects on urban providers in the Delta other than CCWD would be minimal because most Delta providers do not receive CVP or SWP supplies. Conveyance effects on Delta urban providers could involve construction and displacement effects, and water quality effects could be important for some Delta providers.

Storage

Preliminary DWRSIM modeling studies were used to estimate effects on urban water supply. Table 7.5-14 shows the total increase in water supply for the entire Bay Region, including CCWD, under Program alternatives.

Table 7.5-17 shows some characteristics for the Delta Region (CCWD) in 2020. Analysis using the M&I models was conducted. With increased supplies and reduced demand under the Water Use Efficiency Program, CCWD would experience limited need for new supplies in the average hydrologic condition. New stored supplies would be valuable only if they were allowed to replace relatively expensive conservation or recycling. In the dry condition, CCWD would experience a shortage of about 5 TAF, or about 2.5% of demand in the 2020 dry condition. Economic losses of about $500-$600 per acre-foot of shortage could be eliminated with new supplies.

Conveyance

DWR provided a preliminary analysis of salinity. The salinity analysis did not consider differences in the amount of storage or in the amount and timing of exports between alternatives. Rather, only differences in conveyance and intake configurations were modeled. Results are provided in Table 7.5-15 and in Section 5.3. The reduction in salinity at the CCC intake at Rock Slough and at Old River at SR 4 is considered beneficial.

Limited estimates of bromide concentrations also are available. For estimates at the Contra Costa Canal intake and at Old River at SR 4, the Preferred Program Alternative could result in a lower average concentration of bromide than the No Action Alternative. Information is limited, and changes in salinity and concentrations of bromides could be potentially significant. The economic consequences of this effect cannot be estimated at this time.

For estimates at the Contra Costa Canal intake and at Old River at SR 4, the Preferred Program Alternative could result in a lower average concentration of bromide than the No Action Alternative.

Changes in project operations may affect urban water supply economics. Any reductions in water supply caused by changes in the amount of water exported to the Delta Region could result in an adverse effect, depending on the magnitude of the reduction. Any increases in water supply caused by changes in the amount of water exported to this region could result in a beneficial effect.

Bay Region

Modeling results are similar to those described for the Delta Region, except that the demand for new supplies is different and the Bay Region would be affected through different water export facilities.

Storage

Water supply effects occur through deliveries of the NBA and the SBA, and through the San Felipe Division of the CVP. Table 7.5-14 shows the total increase in water supply under Program alternatives. Supplies for the entire Bay Region, which includes CCWD, are increased by 19-44 TAF in comparison to the No Action Alternative, depending on management criteria and priority. The addition of storage to the Preferred Program Alternative increases supply by 13-35 TAF in comparison to the same criteria and priority without storage. Water supply effects with or without the diversion near Hood are similar, except under Criterion A with storage—where the Hood diversion results in about twice as much water supply for the Bay Region.

Table 7.5-17 shows some characteristics for the region in 2020. In the average condition, and with Water Use Efficiency Program recycling and conservation, the Bay Region would have little if any need for new water in 2020. The shortages for the No Action Alternative identified in Table 7.5-17 would be eliminated by the Water Use Efficiency Program conservation savings and recycled water identified in Table 7.5-16.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-18. Without new storage, the new supplies are worth from $0.8 to $3.1 million annually in terms of shortage and other supply costs avoided. With new storage, the new supplies are worth from $2.9 to $10.2 million annually. The average value of new supplies ranges from $136 to $467 per acre-foot.

Table 7.5-18. Results of Least-Cost Analysis of Program Alternatives for the Bay Region

	CRITERION A				CRITERION B			
	NO STORAGE		WITH STORAGE		NO STORAGE		WITH STORAGE	
	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Preferred Program Alternative with Hood diversion facility								
Bay Region average incremental supply (TAF)	4.8	8.8	40.4	44.2	5.2	13.5	18.9	38.4
Bay Region avoided loss/cost ($1,000)	$1,047	$3,134	$18,873	$18,873	$773	$1,843	$2,912	$10,161
Loss/cost per acre-foot new supply	$216	$355	$467	$427	$148	$136	$154	$264
Preferred Program Alternative without Hood diversion facility (Alternative 1)								
Bay Region average incremental supply (TAF)	5.4	8.7	25.7	36.3	5.2	13.1	18.8	38.3
Bay Region avoided loss/cost ($1,000)	$1,048	$3,140	$12,246	$16,312	$795	$1,951	$2,941	$10,171
Loss/cost per acre-foot new supply	$195	$359	$477	$449	$154	$149	$156	$266
Alternative 2								
Bay Region average incremental supply (TAF)	5.0	9.5	24.9	35.1	7.4	18.2	24.3	41.1
Bay Region avoided loss/cost ($1,000)	$1,044	$3,121	$12,243	$16,241	$1,458	$3,145	$3,506	$14,051
Loss/cost per acre-foot new supply	$209	$330	$493	$463	$198	$173	$144	$342
Alternative 3								
Bay Region average incremental supply (TAF)	3.3	5.0	22.8	31.2	4.8	12.7	20.1	37.5
Bay Region avoided loss/cost ($1,000)	$1,043	$3,095	$12,563	$16,460	$1,070	$2,425	$3,604	$11,954
Loss/cost per Acre-foot new supply	$320	$623	$552	$527	$223	$191	$180	$319

Notes:

TAF = Thousand acre-feet.

Conveyance

Limited information on salinity and bromide concentrations is available. For estimates at CCFB, the average salinity and concentration of bromides decreased under the Preferred Program Alternative. This decrease would be a benefit to the Bay Region through the SBA and the San Felipe Division. The economic consequences of this effect cannot be determined at this time.

For estimates at CCFB, the average concentration of bromides decreased under the Preferred Program Alternative.

Sacramento River Region

Modeling results are similar to those reported for the Delta Region except that this region has no potential to be affected by water quality changes related to cross-Delta conveyance. Increased water supply would be obtained by diversion from the Sacramento River or a tributary, or by exchange. With Program actions, the region does not experience any notable water shortage in the average 2020 condition. In dry conditions, about 10 TAF of new supply could be used under 2020 conditions. Water supplies to eliminate this shortage would be worth about $200-$400 per acre-foot.

San Joaquin River Region

Modeling results are similar to those reported for the Delta Region. Because most urban water use in the region does not require water exports from the Delta, water quality would not be affected by Delta conveyance. For providers using water that might be affected by Program actions, about 13 TAF of new supply are needed to meet 2020 demand in the average condition. New supplies would be worth about $200-$400 per acre-foot in terms of avoided costs. In the dry period, an additional 44 TAF could be used, and this supply would be worth about $250-$350 per acre-foot.

Because most urban water use in the region does not require water exports from the Delta, water quality would not be affected by Delta conveyance.

Water quality improvements from improved Delta conveyance would affect a number of small urban providers throughout the region. Estimates of salinity effects are provided in Table 7.5-15.

Other SWP and CVP Service Areas

Table 7.5-14 shows the total increase in water supply for the South Coast Region. Without new storage, the Preferred Program Alternative would create from 10 to 90 TAF of new water supply for the South Coast. With new storage, the Preferred Program Alternative would create from 120 to 270 TAF of new supply, on average.

Table 7.5-17 shows some characteristics for the South Coast and South Lahontan Regions in 2020 under the No Action alternative. In the average condition, and with Water Use Efficiency Program recycling and conservation, the South Coast Region would have little if any need for new water in 2020. The shortages for the No Action Alternative identified in Table 7.5-17 would be eliminated by the Water Use Efficiency Program conservation savings and recycled water identified in Table 7.5-16.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-19. Without new storage, the new supplies are worth from $13 to $41 million annually in terms of shortage and other supply costs avoided. With new storage, the new supplies are worth from $80 to $240 million annually. The average value of new supplies ranges from $430 to $1,450 per acre-foot.

Water quality improvements from improved Delta conveyance would produce a relatively large effect on this region. Estimates of salinity effects are provided in Table 7.5-15. Salinity effects are relatively important to the region because of its higher baseline salt load. This higher salt load is caused primarily by Colorado River salinity. Other important sources of salinity include water softeners and groundwater. Reduced concentrations of bromide and reduced salinity should be economically beneficial to the region.

Salinity effects are relatively important to the region because of its higher baseline salt load. This higher salt load is caused primarily by Colorado River salinity. Other important sources of salinity include water softeners and groundwater.

7.5.8.2 ALTERNATIVE 1

Alternative 1 is similar to the Preferred Program Alternative without the pilot diversion at Hood. Storage under Alternative 1 ranges between 0 and 6.0 MAF; for conveyance, this alternative relies primarily on the current configuration of Delta channels. Under Alternative 1, some selected channel improvements may take place in the south Delta, together with stream flow and stage barriers (or their equivalent) at selected locations.

Table 7.5-14 shows the total increase in water supply for the South Coast and the Bay Regions. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 1; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-18 for the Bay Region and in Table 7.5-19 for the South Coast Region. Results are very similar to those for the Preferred Program Alternative except that, without the pilot diversion facility near Hood, water supplies and benefits under Criterion A with storage increase less in comparison to the No Action Alternative.

Limited estimates of bromide concentrations and salinity are available. Modeling runs (DWRDSM) indicate that Alternative 1 could result in a higher average concentration of bromides in municipal water diversions than the No Action Alternative. The economic consequences of this effect cannot be estimated at this time.

Modeling runs (DWRDSM) indicate that Alternative 1 could result in a higher average concentration of bromides than the No Action Alternative.

7.5.8.3 ALTERNATIVE 2

Storage under Alternative 2 ranges between 0 and 6.0 MAF. This alternative also adds improvements to north Delta channels to accompany the south Delta improvements contemplated under Alternative 1. Alternative 2 also includes a diversion facility near Hood on the Sacramento River.

Table 7.5-14 shows the total increase in water supply for the South Coast and Bay Regions. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 2; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

Salinity and bromide concentrations in municipal water diversions are expected to be reduced under Alternative 2 when compared to the No Action Alternative. However, the economic consequences of this effect cannot be estimated at this time.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-18 for the Bay Region and in Table 7.5-19 for the South Coast Region. Results are very similar to those for the Preferred Program Alternative, except that water supplies and benefits under Criterion A with storage increase less and water supplies under Criterion B generally increase more.

Table 7.5-19. Results of Least-Cost Analysis of Program Alternatives for the South Coast Region

	CRITERION A				CRITERION B			
	NO STORAGE		WITH STORAGE		NO STORAGE		WITH STORAGE	
	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Preferred Program Alternative with Hood diversion facility								
South Coast average incremental supply (TAF)	10.1	24.3	129.6	144.8	31.6	88.0	118.9	267.3
South Coast avoided loss/cost ($1,000)	$12,793	$32,690	$188,193	$207,573	$13,523	$40,562	$80,159	$238,890
Loss/cost per AF new supply	$1,264	$1,344	$1,452	$1,433	$429	$461	$674	$894
Preferred Program Alternative without Hood diversion facility (Alternative 1)								
South Coast average incremental supply (TAF)	9.7	22.0	80.2	118.0	31.0	84.9	118.7	266.1
South Coast avoided loss/cost ($1,000)	$11,089	$29,213	$110,514	$165,276	$13,309	$39,526	$79,506	$233,472
Loss/cost per AF new supply	$1,147	$1,328	$1,377	$1,400	$429	$465	$670	$877
Alternative 2								
South Coast average incremental supply (TAF)	10.2	24.8	77.9	114.2	43.2	121.5	161.8	288.4
South Coast avoided loss/cost ($1,000)	$11,957	$31,595	$108,587	$160,053	$23,199	$78,327	$106,466	$254,050
Loss/cost per AF new supply	$1,178	$1,276	$1,395	$1,402	$537	$645	$658	$881
Alternative 3								
South Coast average incremental supply (TAF)	6.0	13.0	72.7	101.9	28.9	81.9	129.5	259.4
South Coast avoided loss/cost ($1,000)	$5,368	$14,069	$100,424	$139,650	$12,618	$38,667	$81,168	$224,530
Loss/cost per AF new supply	$892	$1,081	$1,381	$1,371	$437	$472	$627	$866

Notes:

af = Acre-feet.
TAF = Thousand acre-feet.

Salinity and bromide concentrations in municipal water diversions are expected to be reduced under Alternative 2 when compared to the No Action Alternative. However, the economic consequences of this effect cannot be estimated at this time.

7.5.8.4 ALTERNATIVE 3

Storage under Alternative 3 ranges from 0 and 6.0 MAF. Alternative 3 adds a new canal connecting the Sacramento river in the north Delta to the SWP and CVP export facilities in the south Delta that would accompany other Delta facilities contemplated under Alternatives 1 and 2.

Table 7.5-14 shows the total increase in water supply for the South Coast and Bay Regions. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 3; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-18 for the Bay Region and in Table 7.5-19 for the South Coast Region. Results are very similar to those for the Preferred Program Alternative, except that water supplies and economic benefit under Criterion A are roughly half the values for the Preferred Program Alternative.

Modeling runs indicate that salinity and bromide concentrations in municipal water diversions would be reduced under Alternative 3 when compared to the No Action Alternative. Economic effects of these effects are as yet undetermined.

Modeling runs indicate that salinity and bromide concentrations would be lower under Alternative 3 when compared to the No Action Alternative. Economic effects of these effects are as yet undetermined.

7.5.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. This programmatic analysis found that the potentially beneficial and adverse effects from implementing any of the Program alternatives when compared to existing conditions are similar to effects identified in Sections 7.5.7 and 7.5.8, which compare the Program alternatives to the No Action Alternative.

A comparison of the Preferred Program Alternative to existing conditions indicates that the adverse socioeconomic effects identified when compared to the No Action Alternative are still adverse when compared to existing conditions.

The benefits provided by the Preferred Program Alternative when compared existing conditions are less than when compared to the No Action Alternative.

The Program is proposing actions that could cause some economic disruption of urban communities. Under the No Action Alternative, urban development would continue and some adverse socioeconomic effects on existing communities could occur as a result of that development. If the Preferred Program Alternative would affect growth, these effects would be added to other urban development effects that would occur under the No Action Alternative. The combination of these effects with other development effects represents the total changes with respect to existing conditions. The Preferred Program Alternative is not expected to affect growth because the costs and amount of new supplies would be about the same as the costs and amounts obtained by other means.

The water supply reliability actions from the Water Use Efficiency, Water Quality, Storage, and Conveyance Elements could improve the availability and quality of water for urban uses, which could result in some socioeconomic benefits above the existing condition baseline. The benefits provided by the Preferred Program Alternative when compared to existing conditions are less than when compared to the No Action Alternative because of the smaller population and less demand for water under existing conditions.

The water supply reliability actions from the Water Use Efficiency, Water Quality, Storage, and Conveyance Elements could improve the availability and quality of water for urban uses, which could result in some socioeconomic benefits above the existing condition baseline.

7.5.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. For a summary comparison of cumulative effects of all resource categories, please refer to Chapter 3. For a description of the projects and programs that contributed to this cumulative effect analysis, please see Attachment A.

The Program is proposing actions that would add to water supplies developed by other project actions. On the other hand, some projects would reduce water supplies, and Program supplies may offset these reductions. Cumulative effects of urban development will continue, and some adverse socioeconomic effects could be compounded by Program actions. Adverse effects resulting from the Preferred Program Alternative would be added to other urban development effects that would occur with cumulative effects. The combination of these effects with other development effects may result in increased population, higher average water costs and, probably, lower per capita use. An alternative view is that developed water supplies will increase to meet any level of growth. According to this view, Program supplies merely replace other supplies that would be used to meet the growth and there is no or little effect on growth.

The Program is proposing actions that would add to water supplies developed by other project actions. On the other hand, some projects would reduce water supplies, and Program supplies may offset these reductions.

Growth-Inducing Effects. Increased water supplies or lower water costs could induce growth. Program actions that restore ecosystems or recover species could induce growth by reducing regulatory constraints and costs.

Increased water supplies or lower water costs could induce growth. It is likely that Program water supplies will be comparable in cost to other water supply options.

If increases in water supply are caused by the Preferred Program Alternative, the Preferred Program Alternative could induce growth, depending on how additional water supply was used. If additional water was used to expand industry or urban housing development, the proposed action would foster economic and population growth. The significance of the urban water supply economics effect would depend on where population growth occurred and how it was managed.

However, Program supplies are likely to replace other supplies, not add to them; therefore, the total amount of water supply and subsequent urban growth probably would not be affected. It is likely that Program water supplies will be comparable in cost to other water supply options. If Program water is more expensive than other supplies, higher water supply costs actually could inhibit economic growth. The effect is not expected to be substantial in either case.

Short- and Long-Term Relationships. No relationships between short-term uses of the environment and the maintenance and enhancement of long-term productivity have been identified for this resource.

Irreversible and Irretrievable Commitments. Costs and resources committed to a fixed water supply structure cannot be easily reversed. For urban water supply economics, costs must be paid in advance and cannot be recovered even if water supply or water quality benefits do not occur. Program water supply increases are not expected to induce growth, but urbanization would be costly to reverse or relocate if water supplies become unavailable.

7.5.11 ADVERSE EFFECTS

This preliminary analysis has identified no unavoidable adverse effects related to urban water supply economics. Additional analysis is required to fully determine economic effects, when cost and cost allocation information are available.

This preliminary analysis has identified no unavoidable adverse effects related to urban water supply economics. Additional analysis is required to fully determine effects, when cost and cost allocation information are available.

7.5.12 LCPSIM URBAN WATER SUPPLY ECONOMICS ASSESSMENT

The LCPSIM has been developed to assess the economic benefits and costs of increasing water service reliability to urban areas by evaluating the economic consequences of the yearly changes in demands and availability of water supplies. The LCPSIM measures water service reliability benefits by estimating the ability of shortage management (contingency) measures to mitigate regional costs and losses associated with a shortage. Assumptions about the effectiveness of regional long-term and shortage contingency options that can be employed to enhance reliability are incorporated into the LCPSIM along with estimates of their costs. One of the primary objectives of the LCPSIM is to develop an economically efficient regional water management plan.

One of the primary objectives of the LCPSIM is to develop an economically efficient regional water management plan.

In LCPSIM, a priority-based objective, mass balance-constrained linear programming solution is used to simulate regional water management operations on a yearly time-step, including the operation of surface and groundwater carryover storage capacity assumed to be available to the region. Economic losses due to shortage events are based on a residential water user loss function. The cost of adding regional long-term water management measures is determined using a quadratic-programming algorithm. Quadratic programming also is used to simulate water market purchases during shortage events, solving for the least-cost combination of shortage-related economic losses and the cost of transferred water. Demand hardening—the increase in the size of the economic losses associated with specific shortage events—is related to the level of use of regional long-term conservation measures. The least-cost combination of economic risk, regional long-term water management facilities and programs, and contingency water transfers is identified within the model for each alternative water management plan being evaluated. Figure 7.5-3 shows the major model logic flows. Figure 7.5-4 provides the details of the inputs.

The LCPSIM takes a comprehensive view of water supply reliability, incorporating key information on the frequency, size, and effects of shortages. Regional water managers and users must respond primarily to actual year-to-year fluctuations in demand level and water supply availability rather than to average levels of demand and supply. As shortages increase in magnitude and regularity, shortage management becomes increasingly important. The LCPSIM evaluates the economic justification of the level of reliability enhancement provided by any combination of long-term water management options in the context of regionally available contingency options. Regional water management options are divided into three categories: (1) shortage contingency demand management and supply augmentation, (2) long-term demand management and supply enhancement, and (3) economic risk management. The latter accepts a known degree of economic risk from shortages to avoid the use of other water management options that are perceived to be even more costly. Demands were based on the 2020-level values developed for DWR's Bulletin 160-98 and include the forecasted levels of adoption of BMPs for urban conservation.

The LCPSIM takes a comprehensive view of water supply reliability—incorporating key information on the frequency, size, and effects of shortages.

The LCPSIM model was run for both the Bay Region and the South Coast Region. Demands were based on the 2020-level values developed for DWR's Bulletin 160-98 and include the forecasted levels of adoption of BMPs for urban conservation. The residential user loss function was assumed to be the same for both regions. Shown in Figure 7.5-5 is the willingness to pay to avoid one-time shortages of specific sizes by residential customers with specified annual water use rates (use per year per household). Users in the commercial and industrial water use sectors–where, above a threshold shortage size, marginal losses were assumed to be higher–were allocated proportionately less of the overall shortage during shortage events by the LCPSIM logic in order to allow the application of this loss function to the entire shortage.

The LCPSIM model was run for both the Bay Region and the South Coast Region.

Carryover storage capacity allows a current year supply which is in excess of current year use to be held over to meet use during years with supply deficiencies. Carryover storage capacity can exist in surface reservoirs or in groundwater basins. The operation of groundwater capacity is generally less effective for shortage management because annual refill (put) and extraction (take) rates can be relatively limited compared to reservoir storage capacity. Shown in Figure 7.5-6 are the carryover storage assumptions used for the South Coast Region.

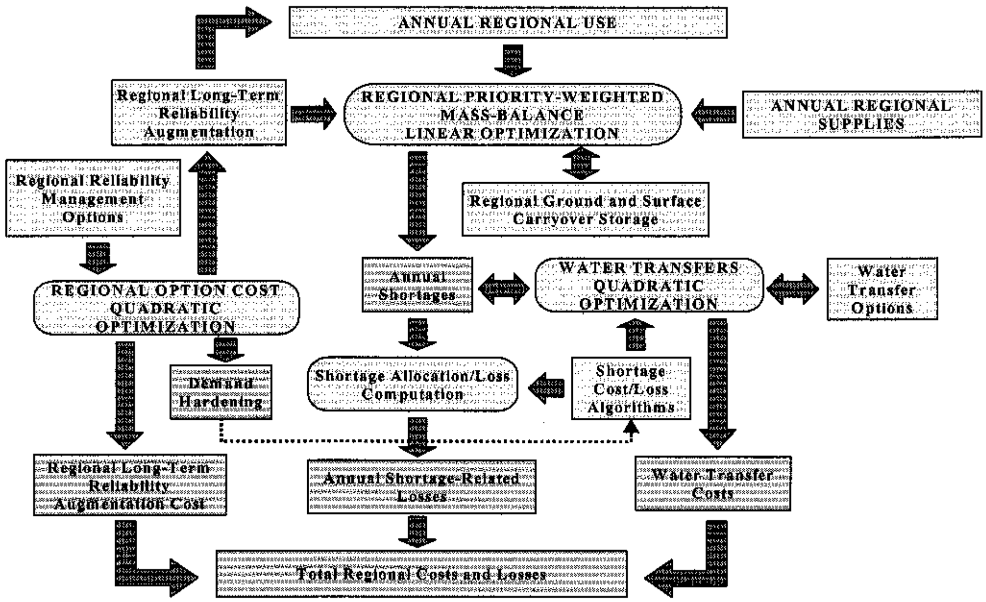

Figure 7.5-3. LCPSIM Logic Flows

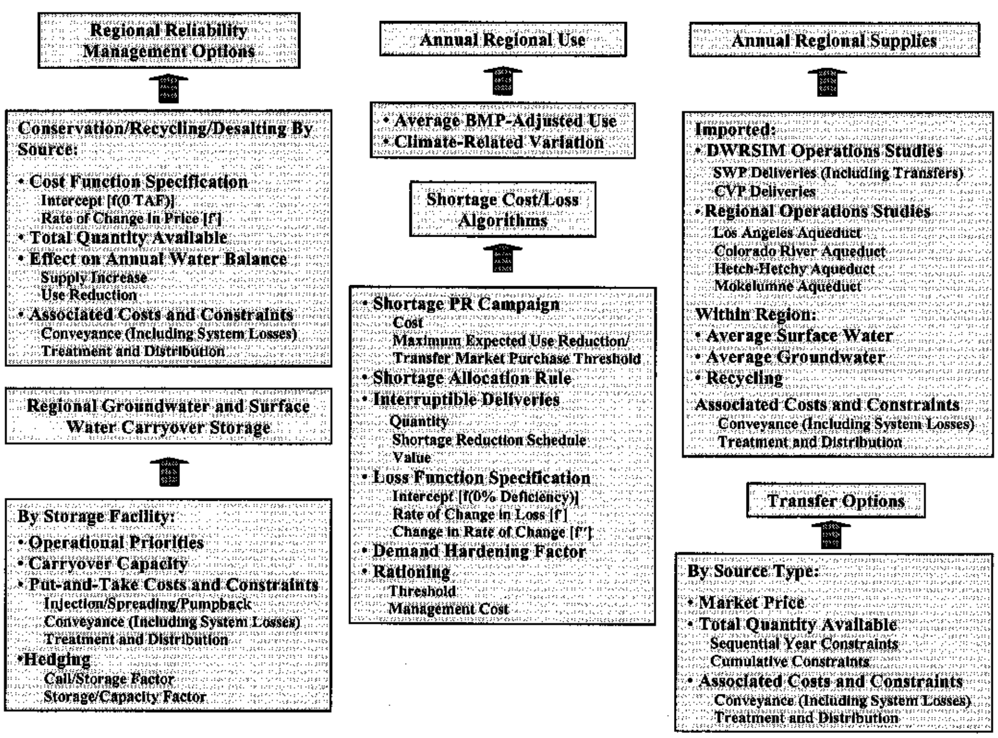

Figure 7.5-4. LCPSIM Input Data and Parameters

Deficiency	Willingness to Pay per Shortage Event by Acre-Foot per Year per Household		
	0.75	0.65	0.55
0%	$0	$0	$0
5%	$49	$43	$36
10%	$145	$126	$106
15%	$278	$241	$204
20%	$439	$380	$322
25%	$618	$535	$453
30%	$804	$697	$590
35%	$990	$858	$726

Figure 7.5-5. LCPSIM Loss Function

Operation	Capacity (TAF)	Initial Fill	Recharge Efficiency	Put Limit (TAF)	Put Cost	Take Limit (TAF)	Take Cost	Description
1	160	100%	100%	160	$0	160	$0	Terminal Reservoirs
2	660	50%	100%	200	$0	660	$0	Local Reservoir Augmentation
3	1,500	50%	100%	30	$0	400	$16	Local Groundwater In-Lieu Recharge
4	1,500	50%	95%	170	$15	400	$16	Local Groundwater Spreading Recharge
5	660	50%	100%	660	$0	660	$0	Local Reservoir Augmentation
6	100	50%	95%	55	$90	70	$85	Local Banking
7	350	50%	95%	55	$90	55	$85	External Banking

Figure 7.5-6. South Coast Region Carryover Storage Capacities

The capacities listed are not additive for the South Coast Region because Operations 2 and 5 share the same surface reservoir storage capacity. Similarly, Operations 3 and 4 share the same groundwater storage capacity. The operations are separately identified in the model to allow for differences in refill and use operations in terms of priority, cost, or rate. Operation 1, terminal reservoir storage, is also identified separately because of differences in priority of refill and use compared to other surface reservoir storage.

Shown in Figure 7.5-7 are the carryover storage capacity assumptions for the Bay Region. This capacity includes recent agreements for banking water in the Tulare Lake basin, patterned after the agreement made for the South Coast Region (Operation 7, above).

Operation	Capacity (TAF)	Initial Fill	Recharge Efficiency	Put Limit (TAF)	Put Cost	Take Limit (TAF)	Take Cost	Description
1	100	50%	100%	100	$0	100	$0	Local Reservoir Storage
2	100	50%	95%	100	$15	20	$16	Local Groundwater Spreading
3	443	50%	95%	70	$90	70	$85	External Banking

Figure 7.5-7. Bay Region Carryover Storage Capacities

Shortage contingency water transfers were assumed to be available for both regions. The maximum annual level of contingency transfers assumed to be available from the Central Valley was 400 TAF for the South Coast Region and 100 TAF for the Bay Region, the amounts assumed to be available through the State Drought Water Bank and other transfer options. Transfer option were assumed to cost about $175 per acre-foot, excluding conveyance (specified conveyance costs are added within LCPSIM). Each transfer was constrained not to occur over 25% of the time unless the quantity transferred was less than the maximum annual amount available (that is, 250% of the maximum annual amount in any 10-year period). If less than the maximum available was transferred, the frequency could be proportionately higher. The quantity transferred during any two consecutive years also could exceed the maximum annual amount available. These constraints apply independently to each transfer source identified. In addition, transfers could only be used when the available regional supplies were below 93% of current consumptive demand. Up to a 7% shortage was assumed to be relatively easily managed with a contingency conservation program that the model assumes would be triggered by a shortage of this size.

Shortage contingency water transfers were assumed to be available for both regions.

Long-term demand management options that are adopted by water users can have a demand "hardening" effect. Although they can increase reliability by reducing the size, frequency and duration of shortage events, they can make these events relatively more costly when they do occur. This occurs because these options tend to reduce the "slack" in the system (that is, reduce or eliminate the least valuable water uses and/or the least efficient water use methods). This means that things are already "closer to the bone" for users and they are more vulnerable when shortages happen. For LCPSIM runs, the hardening factor was assumed to be 50% (that is, if conservation decreases demand by 10%, the economic effect of a shortage of a specified size was computed as if the shortage was actually 5% greater).

Long-term demand management options that are adopted by water users can have a demand "hardening" effect. Although they can increase reliability by reducing the size, frequency and duration of shortage events, they can make these events relatively more costly when they do occur.

Figure 7.5-8 is the option input table used for the South Coast Region. Information from DWR Bulletin 160-98 was used to develop the data in the table. The conservation options shown in this figure (and in Figure 7.5-9) represent actions beyond those assumed to have been implemented to achieve the level of conservation already incorporated in the study demands due to the adoption of BMPs.

One difference in the assumptions on available options for the South Coast Region was that the Bulletin assumed that diversions from the Colorado River Aqueduct were held at 550 TAF in the base case. Transfer, conservation, and land fallowing options for the Colorado River Region to augment this supply were developed for the Bulletin. For the purposes of the current LCPSIM study, the amount of water assumed to be imported through the Colorado River Aqueduct was assumed to be held at a constant 1.1 MAF to account for plans by the MWD and the San Diego County Water Authority plans for imports in the future. Consequently, no options were included which involved additional water being wheeled through the aqueduct since it is essentially at capacity under this assumption.

Figure 7.5-9 is the option input table used for the Bay Region, which also was developed from information used in Bulletin 160-98.

Source	Amount Available (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	67	$750	$0.00	2	Conservation I (New Development - Outdoor)
2	110	$400	$0.00	2	Conservation II (Indoor - 60 GPCD)
3	110	$800	$0.00	2	Conservation II (Indoor - 55 GPCD)
4	30	$500	$0.00	2	Conservation III (3% Nonresidential Use)
5	18	$1,167	$0.00	2	Conservation III (5% Nonresidential Use)
6	84	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	93	$395	$3.20	1	Groundwater Recovery I
8	2	$890	$0.00	1	Groundwater Recovery II
9	4	$179	$0.00	1	Water Recycling I
10	236	$236	$0.70	1	Water Recycling II
11	226	$433	$2.40	1	Water Recycling III
12	13	$1,180	$0.00	1	Water Recycling IV
13	5	$2,147	$165.00	1	Water Recycling V
14	5	$920	$0.00	1	Ocean Water Desalting I
15	100	$1,030	$0.00	1	Ocean Water Desalting II
16	900	$1,700	$0.00	1	Ocean Water Desalting III

Figure 7.5-8. South Coast Region Options

Source	Amount Available (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	2	$750	$0.00	2	Conservation I (New Development - Outdoor)
2	38	$400	$0.00	2	Conservation II (Indoor - 60 GPCD)
3	38	$800	$0.00	2	Conservation II (Indoor - 55 GPCD)
4	11	$500	$0.00	2	Conservation III (3% Nonresidential Use)
5	7	$1,167	$0.00	2	Conservation III (5% Nonresidential Use)
6	13	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	9	$510	$0.00	1	Groundwater Recovery I
8	20	$95	$0.00	1	Water Recycling I
9	4	$243	$0.00	1	Water Recycling II
10	24	$563	$28.50	1	Water Recycling III
11	1	$2,381	$0.00	1	Water Recycling IV

Figure 7.5-9. Bay Region Options

Price elasticity of water demand was considered in two ways. The economic optimization logic used in LCPSIM depends on comparing the marginal cost of additional regional conservation to the marginal cost of additional regional supply and the marginal expected cost of shortages. Demand is therefore a function of the overall regional economic efficiency of water management in light of the Program alternative being evaluated.

The Program alternatives were evaluated with LCPSIM by running the model with the CVP and SWP deliveries expected under the No Action Alternative to obtain the least-cost combination of shortage-related costs and losses (including shortage management costs) and the investment and operations costs of long-term water management options (that is, the least-cost solution). The model then was run with the change in deliveries expected with each Program alternative. The least-cost solution for each Program alternative then was compared to the original results.

Because the increased CVP and SWP deliveries, particularly during dry and critical years, LCPSIM achieved a least-cost solution with lower total costs (that is, a superior least-cost solution) with each of the Program alternatives. This was achieved either by a reduction in expected shortage-related costs and losses or by avoiding the costs associated with long-term water management options no longer needed to achieve the least-cost solution, or both. It should be noted that some superior least-cost solutions can result in higher shortage-related costs and losses or higher costs associated with long-term water management options but the net effect is a lower total cost.

Because the increased CVP and SWP deliveries, particularly during dry and critical years, LCPSIM achieved a least-cost solution with lower total costs (that is, a superior least-cost solution) with each of the Program alternatives.